Allen-Bradley

MicroLogix™ 1200 RTD/Resistance Input Module

(Catalog Number 1762-IR4)

User Manual

Rockwell Automation

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of these products must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards. In no event will Rockwell Automation be responsible or liable for indirect or consequential damage resulting from the use or application of these products.

Any illustrations, charts, sample programs, and layout examples shown in this publication are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Rockwell Automation office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

Throughout this publication, notes may be used to make you aware of safety considerations. The following annotations and their accompanying statements help you to identify a potential hazard, avoid a potential hazard, and recognize the consequences of a potential hazard:

WARNING	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
ATTENTION	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Preface

Chapter 1
Overview

Chapter 2
Installation and Wiring

Chapter 3

Module Data, Status, and Channel Configuration

Chapter 4

Diagnostics and Troubleshooting

Read this preface to familiarize yourself with the rest of the manual. This preface covers the following topics:

- who should use this manual
- how to use this manual
- related publications
- conventions used in this manual
- Rockwell Automation support

Who Should Use This Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use MicroLogix 1200 controllers and 1762 Expansion I/O.

How to Use This Manual

As much as possible, we organized this manual to explain, in a task-by-task manner, how to install, configure, program, operate and troubleshoot a control system using the 1762-IR4.

Manual Contents

If you want...	See
An overview of the RTD/resistance input module	Chapter 1
Installation and wiring guidelines	Chapter 2
Module addressing, configuration and status information	Chapter 3
Information on module diagnostics and troubleshooting	Chapter 4
Specifications for the module	Appendix A
Information on programming the module using MicroLogix 1200 and RSLogix 500	Appendix B
Information on understanding two's complement binary numbers	Appendix C
Definitions of terms used in this manual	Glossary

Related Documentation

The table below provides a listing of publications that contain important information about MicroLogix 1200 systems.

For	Read this document	Document number
A user manual containing information on how to install, use and program your MicroLogix 1200 controller	MicroLogix™ 1200 User Manual	1762-UM001
An overview of the MicroLogix 1200 System, including 1762 Expansion I/O.	MicroLogix™ 1200 Technical Data	1762-TD001
In-depth information on programming and using MicroLogix 1200 controllers.	MicroLogix 1200 Instruction Set Reference Manual	1762-RM001
In-depth information on grounding and wiring Allen-Bradley programmable controllers.	Allen-Bradley Programmable Controller Grounding and Wiring Guidelines	1770-4.1

If you would like a manual, you can:

- download a free electronic version from the internet at **www.theautomationbookstore.com**
- purchase a printed manual by:
  - contacting your local distributor or Rockwell Automation representative
  - visiting www.theautomationbookstore.com and placing your order
  - calling 1.800.963.9548 (USA/Canada) or 001.330.725.1574 (Outside USA/Canada)

Conventions Used in This Manual

The following conventions are used throughout this manual:

- Bulleted lists (like this one) provide information not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- Italic type is used for emphasis.

Rockwell Automation Support

Rockwell Automation tests all of our products to ensure that they are fully operational when shipped from the manufacturing facility.

If you are experiencing installation or startup problems, please review the troubleshooting information contained in this publication first. If you need technical assistance to get your module up and running, please contact Customer Support (see the table below); our trained technical specialists are available to help.

If the product is not functioning and needs to be returned, contact your distributor. You must provide a Customer Support case number to your distributor in order to complete the return process.

Phone	United States/Canada	1.440.646.5800
	Outside United States/Canada	You can access the phone number for your country via the Internet: 1. Go to http://support.rockwellautomation.com/ 2. Under *Contacting Customer Support* and Other Countries, click on *Click here*
Internet	Worldwide	Go to http://support.rockwellautomation.com/

Your Questions or Comments on the Manual

If you find a problem with this manual, please notify us. If you have any suggestions for how this manual could be made more useful to you, please contact us at the address below:

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Automation Control and Information Group
Technical Communication, Dept. A602V
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Milwaukee, WI 53201-2086

Overview

This chapter describes the four-channel 1762-IR4 RTD/resistance Input module and explains how the controller reads resistance temperature detector (RTD) or direct resistance-initiated analog input data from the module. Included is:

- a general description of hardware features
- an overview of module and system operation
- compatibility

General Description

The 1762-IR4 module supports RTD and direct resistance signal measurement applications that require up to four channels. The module digitally converts analog data and then stores the converted data in its image table.

The module supports connections from any combination of up to four input devices. Each channel is individually configurable via software for 2- or 3-wire RTD or direct resistance input devices. Channels are compatible with 4-wire sensors, but the fourth sense wire is not used. Two programmable excitation current values (0.5mA and 1.0mA) are provided, to limit RTD self-heating. When configured for RTD inputs, the module can convert the RTD readings into linearized digital temperature readings in °C or °F. When configured for resistance analog inputs, the module can convert voltages into linearized resistance values in ohms. The module assumes that the direct resistance input signal is linear prior to input to the module.

Each channel provides open-circuit (all wires), short-circuit (excitation and return wires only), and over- and under-range detection and indication.

IMPORTANT The module accepts input from RTDs with up to 3 wires. If your application requires a 4-wire RTD, one of the two lead compensation wires is not used, and the RTD is treated like a 3-wire sensor. The third wire provides lead wire compensation. See Chapter 2, *Installation and Wiring*, for more information.

The following data formats are supported by the module.:

- raw/proportional
- engineering units x 1
- engineering units x 10
- scaled-for-PID
- percent full scale

Available filter frequencies are:

- 10 Hz
- 50 Hz
- 60 Hz
- 250 Hz
- 500 Hz
- 1 kHz

The module uses six input words for data and status bits and five configuration words. Module configuration is stored in the controller memory. Normally configuration is done via the controller's programming software. In addition, some controllers support configuration via the user program. Refer to your controller manual for additional information. See Chapter 3, *Module Data, Status, and Channel Configuration,* for details on module configuration.

RTD Compatibility

An RTD consists of a temperature-sensing element connected by two, three, or four wires that provide input to the module. The following table lists the RTD types that you can use with the module, including their temperature range, effective resolution, and repeatability for both excitation currents, 0.5 and 1.0 mA.

Table 1.1 RTD Specifications

RTD Type[(1)]		Temperature Range Using 0.5 mA Excitation	Temperature Range Using 1.0 mA Excitation	Maximum Scaled Resolution	Maximum Scaled Repeatability
Copper 426	10Ω	Not allowed	-100 to 260°C (-148 to 500°F)	0.1°C (0.1°F)	±0.2°C (±0.4°F)
Nickel 618[(2)]	120Ω	-100 to 260°C (-148 to 500°F)	-100 to 260°C (-148 to 500°F)	0.1°C (0.1°F)	±0.1°C (±0.2°F)
Nickel 672	120Ω	-80 to 260°C (-112 to 500°F)	-80 to 260°C (-112 to 500°F)	0.1°C (0.1°F)	±0.1°C (±0.2°F)
Nickel-Iron 518	604Ω	-100 to 200°C (-148 to 392°F)	-100 to +200°C (-148 to 392°F)	0.1°C (0.1°F)	±0.1°C (±0.2°F)
Platinum 385	100Ω	-200 to 850°C (-328 to 1562°F)	-200 to 850°C (-328 to 1562°F)	0.1°C (0.1°F)	±0.2°C (±0.4°F)
	200Ω	-200 to 850°C (-328 to 1562°F)	-200 to 850°C (-328 to 1562°F)	0.1°C (0.1°F)	±0.2°C (±0.4°F)
	500Ω	-200 to 850°C (-328 to 1562°F)	-200 to 850°C (-328 to 1562°F)	0.1 °C (0.1 °F)	±0.2°C (±0.4°F)
	1000Ω	-200 to 850°C (-328 to 1562°F)	Not Allowed	0.1°C (0.1°F)	±0.2°C (±0.4°F)
Platinum 3916	100Ω	-200C to 630°C (-328 to 1166°F)	-200 to 630°C (-328 to 1166°F)	0.1°C (0.1°F)	±0.2°C (±0.4°F)
	200Ω	-200 to 630°C (-328 to 1166°F)	-200 to 630°C (-328 to 1166°F)	0.1°C (0.1°F)	±0.2°C (±0.4°F)
	500Ω	-200 to 630°C (-328 to 1166°F)	-200 to 630°C (-328 to 1166°F)	0.1°C (0.1°F)	±0.2°C (±0.4°F)
	1000Ω	-200 to 630°C (-328 to 1166°F)	Not Allowed	0.1°C (0.1°F)	±0.2°C (±0.4°F)

(1) Digits following the RTD type represent the temperature coefficient of resistance (α), which is defined as the resistance change per ohm per °C. For instance, platinum 385 refers to a platinum RTD with α = 0.00385 ohm/ohm -°C, or simply 0.00385/°C.

(2) Actual value at 0°C is 100 Ω per DIN standard.

The tables below provide specifications for RTD accuracy and temperature drift.

Table 1.2 RTD Accuracy and Temperature Drift

RTD Type		Maximum Scaled Accuracy (25°C with Calibration)	Maximum Scaled Accuracy (0 to 55°C with Calibration)	Maximum Temperature Drift (from 25°C without Calibration)
Copper 426	10Ω	±0.6°C (1.08°F)	±1.1°C (1.98°F)	±0.032°C/°C (0.032°F/°F)
Nickel 618	120Ω	±0.2°C (±0.36°F)	±0.4° C (±0.72°F)	±0.012°C/° C (±0.012°F/°F)
Nickel 672	120Ω	±0.2°C (±0.36°F)	±0.4° C (±0.72°F)	±0.012°C/° C (±0.012°F/°F)
Nickel-Iron 518	604Ω	±0.3°C (±0.54°F)	±0.5° C (±0.9°F)	±0.015°C/° C (±0.015°F/°F)
Platinum 385	100Ω	±0.5°C (±0.9°F)	±0.9° C (±1.62°F)	±0.026°C/° C (±0.026°F/°F)
	200Ω	±0.5°C (±0.9°F)	±0.9° C (±1.62°F)	±0.026°C/° C (±0.026°F/°F)
	500Ω	±0.5°C (±0.9°F)	±0.9° C (±1.62°F)	±0.026°C/° C (±0.026°F/°F)
	1000Ω	±0.5°C (±0.9°F)	±0.9° C (±1.62°F)	±0.026°C/° C (±0.026°F/°F)
Platinum 3916	100Ω	±0.4°C (±0.72°F)	±0.8° C (±1.44°F)	±0.023°C/° C (±0.023°F/°F)
	200Ω	±0.4°C (±0.72°F)	±0.8° C (±1.44°F)	±0.023°C/° C (±0.023°F/°F)
	500Ω	±0.4°C (±0.72°F)	±0.8° C (±1.44°F)	±0.023°C/° C (±0.023°F/°F)
	1000Ω	±0.4°C (±0.72°F)	±0.8° C (±1.44°F)	±0.023°C/° C (±0.023°F/°F)

IMPORTANT

Using Table 1.2 to Calculate Module Accuracy:

For example, when you are using any platinum (385) RTDs with 0.5 mA excitation current, the module's accuracy is:

- ±0.5°C (0.9°F) after you apply power to the module or perform an autocalibration at 25°C (77°F) ambient, with module operating temperature at 25°C (77°F).
- ±[0.5°C (0.9°F) ± DT x 0.026 deg./°C (0.026 deg./°F)] after you apply power to the module or perform an autocalibration at 25°C (77°F) ambient, with module operating temperature between 0 (32°F) and 55°C (131°F). DT is the temperature difference between the actual module operating temperature and 25°C (77°F). The value 0.026 deg./°C (0.026 deg./°F) is the temperature drift shown in the table above.
- ±0.9°C after you apply power to the module or perform an autocalibration at 55°C (131°F) ambient, with module operating temperature at 55°C (131°F).

Resistance Device Compatibility

The following table lists the specifications for the resistance devices that you can use with the module.

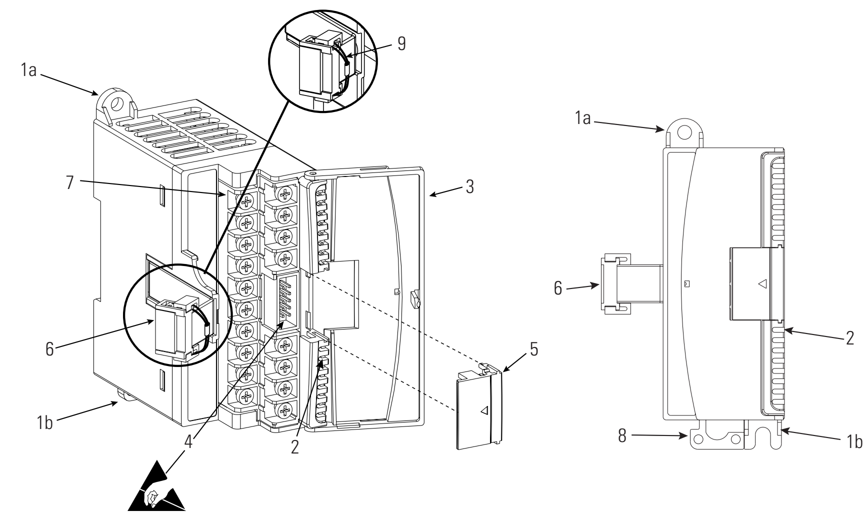
Table 1.3 Resistance Device Specifications

Resistance Device Type	Resistance Range (0.5 mA Excitation)	Resistance Range (1.0 mA Excitation)	Accuracy(1)	Temperature Drift	Resolution	Repeatability
150Ω	0 to 150Ω	0 to 150Ω	±0.15Ω	±0.007Ω/°C (±0.012Ω/°F)	0.01Ω	±0.04Ω
500Ω	0 to 500Ω	0 to 500Ω	±0.5Ω	±0.023Ω/°C (±0.041Ω/°F)	0.1Ω	±0.2Ω
1000Ω	0 to 1000Ω	0 to 1000Ω	±1.0Ω	±0.043Ω/°C (±0.077Ω/°F)	0.1Ω	±0.2Ω
3000Ω	0 to 3000Ω	Not allowed	±1.5Ω	±0.072Ω/°C (±0.130Ω/°F)	0.1Ω	±0.2Ω

(1) Accuracy values are based on the assumption that the module has been calibrated to the temperature range of 0 to 55°C (32 to 131°F).

Hardware Features

The RTD/resistance module provides connections for four 3-wire inputs for any combination of RTD and resistance input devices. Channels are wired as differential inputs. The illustration below shows the hardware features of the module.



Item	Description
1a	upper panel mounting tab
1b	lower panel mounting tab
2	power diagnostic LED
3	module door with terminal identification label
4	bus connector with male pins
5	bus connector cover
6	flat ribbon cable with bus connector (female)
7	terminal block
8	DIN rail latch
9	pull loop

General Diagnostic Features

A single diagnostic LED helps you identify the source of problems that may occur during power-up or during normal channel operation. The LED indicates both status and power. See Chapter 4, *Diagnostics and Troubleshooting*, for details on power-up and channel diagnostics.

System Overview

The modules communicate to the local controller or communication adapter through the 1762 bus interface. The modules also receive 5 and 24V dc power through the bus interface.

System Operation

At power-up, the module performs a check of its internal circuits, memory, and basic functions. During this time, the module status LED remains off. If no faults are found during power-up diagnostics, the module status LED is turned on.

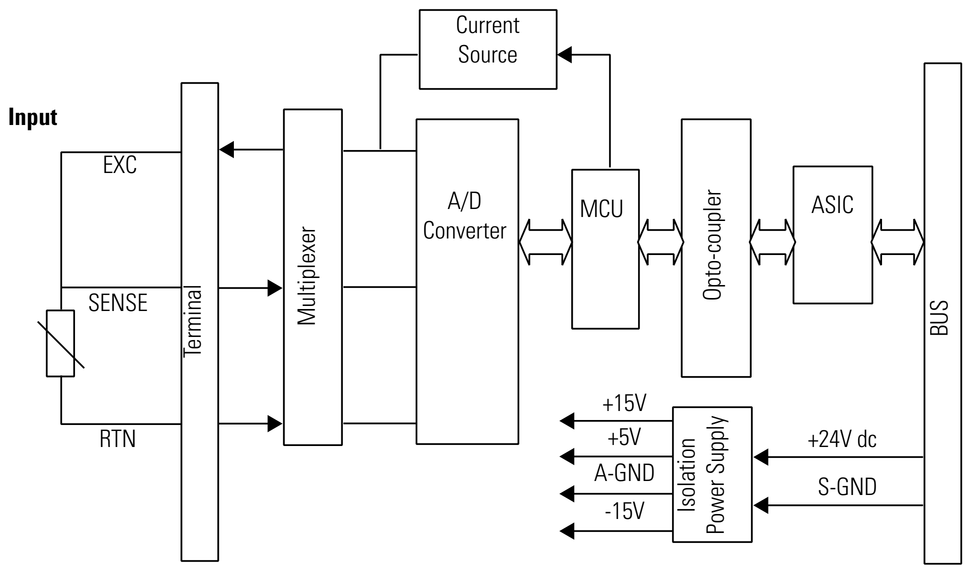
After power-up checks are complete, the module waits for valid channel configuration data. If an invalid configuration is detected, the module generates a configuration error. Once a channel is properly configured and enabled, the module continuously converts the RTD or resistance input to a value within the range selected for that channel.

Each time the module reads an input channel, it tests the data for a fault (over- or under-range, short-circuit, or open-circuit condition). If it detects a fault, the module sets a unique bit in the channel status word. See Input Data File on page 3-3.

Using the module image table, the controller reads the two's compliment binary converted input data from the module. This typically occurs at the end of the program scan or when commanded by the control program. If the controller and the module determine that the data transfer has been made without error, the data is used in the control program.

Module Operation

As shown in the block diagram below, each input channel of the module consists of an RTD/resistance connection that accepts excitation current; a sense connection that detects lead wire resistance; and a return connection. The signals are multiplexed to an A/D converter that reads the RTD or resistance value and the lead wire resistance.



From the readings taken by the converter, the module returns an accurate temperature or resistance to the controller user program through the microprocessor. The module uses two bidirectional serial ports for communication, each using an optocoupler for isolation. A third optocoupler is used to reset the microprocessor if the module detects a loss of communication.

Module Field Calibration

The input module performs autocalibration when a channel is initially enabled. Autocalibration compensates for offset and gain drift of the A/D converter caused by temperature change within the module. An internal, high-precision, low drift voltage and system ground reference is used for this purpose. In addition, you can program the module to perform a calibration cycle once every 5 minutes. See Selecting Enable/Disable Cyclic Autocalibration (Word 4, Bit 0) on page 3-20 for information on configuring the module to perform periodic calibration.

Installation and Wiring

This chapter tells you how to:

- determine the power requirements for the modules
- avoid electrostatic damage
- install the module
- wire the module's terminal block
- wire input devices

Compliance to European Union Directives

This product is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

The 1762-IR4 module is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2
  EMC – Generic Emission Standard, Part 2 - Industrial Environment

- EN 50082-2
  EMC – Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 – Equipment Requirements and Tests.

For specific information required by EN61131-2, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- *Industrial Automation, Wiring and Grounding Guidelines for Noise Immunity*, publication 1770-4.1
- *Automation Systems Catalog*, publication B113

Power Requirements

The module receives +5V dc and 24V dc power from the system power supply through the bus interface.

The maximum current drawn by the module is shown in the table below.

5V dc	24V dc
40 mA	50 mA

TIP When you configure your system, ensure that the total current draw of all the modules does not exceed the maximum current output of the system power supply.

General Considerations

1762 I/O is suitable for use in an industrial environment when installed in accordance with these instructions. Specifically, this equipment is intended for use in clean, dry environments (Pollution degree 2[(1)]) and to circuits not exceeding Over Voltage Category II[(2)] (IEC 60664-1).[(3)]

(1) Pollution Degree 2 is an environment where, normally, only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation shall be expected.

(2) Over Voltage Category II is the load level section of the electrical distribution system. At this level transient voltages are controlled and do not exceed the impulse voltage capability of the product’s insulation.

(3) Pollution Degree 2 and Over Voltage Category II are International Electrotechnical Commission (IEC) designations.

Hazardous Location Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. The following WARNING statement applies to use in hazardous locations.

WARNING

EXPLOSION HAZARD

- Substitution of components may impair suitability for Class I, Division 2.
- Do not replace components or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
- Do not connect or disconnect components unless power has been switched off or the area is known to be non-hazardous.
- This product must be installed in an enclosure.
- All wiring must comply with N.E.C. article 501-4(b).

Prevent Electrostatic Discharge

ATTENTION

Electrostatic discharge can damage integrated circuits or semiconductors if you touch I/O module bus connector pins or the terminal block on the input module. Follow these guidelines when you handle the module:

- Touch a grounded object to discharge static potential.
- Wear an approved wrist-strap grounding device.
- Do not touch the bus connector or connector pins.
- Do not touch circuit components inside the module.
- If available, use a static-safe work station.
- When it is not in use, keep the module in its static-shield box.

Remove Power

ATTENTION

Remove power before removing or inserting this module. When you remove or insert a module with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing unintended machine motion
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector and may lead to premature failure.

Selecting a Location

Reducing Noise

Most applications require installation in an industrial enclosure to reduce the effects of electrical interference. RTD inputs are highly susceptible to electrical noise. Electrical noise coupled to the RTD inputs will reduce the performance (accuracy) of the module.

Group your modules to minimize adverse effects from radiated electrical noise and heat. Consider the following conditions when selecting a location for the module. Position the module:

- away from sources of electrical noise such as hard-contact switches, relays, and AC motor drives
- away from modules which generate significant radiated heat. Refer to the module's heat dissipation specification.

In addition, route shielded, twisted-pair wiring away from any high voltage I/O wiring.

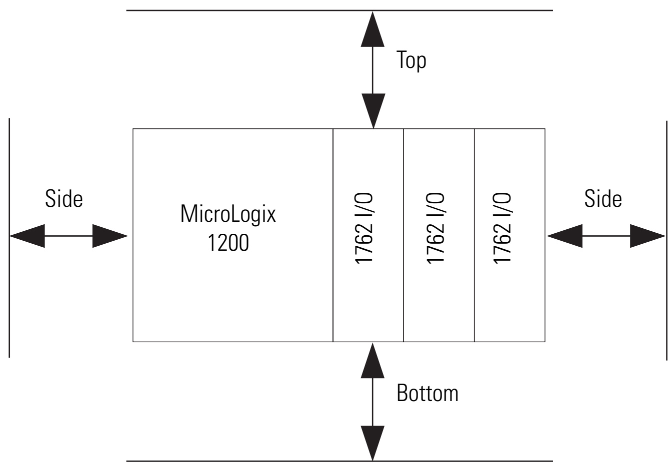
Mounting

ATTENTION

Do not remove protective debris strip until after the module and all other equipment near the module is mounted and wiring is complete. Once wiring is complete and the module is free of debris, carefully remove the protective debris strip. Failure to remove the strip before operating can cause overheating.

Minimum Spacing

Maintain spacing from enclosure walls, wireways, adjacent equipment, etc. Allow 50.8 mm (2 in.) of space on all sides for adequate ventilation, as shown below:



TIP

1762 I/O may be mounted horizontally only.

ATTENTION

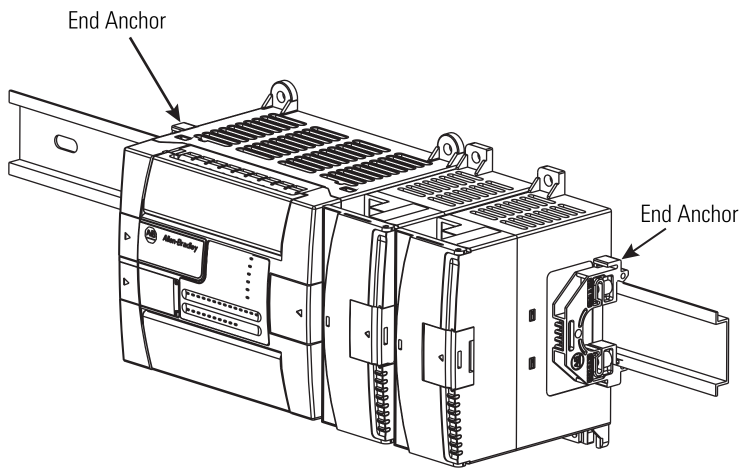
During DIN rail or panel mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the module. Debris that falls into the module could cause damage at power up.

DIN Rail Mounting

The module can be mounted using the following DIN rails: 35 x 7.5 mm (EN 50 022 - 35 x 7.5) or 35 x 15 mm (EN 50 022 - 35 x 15).

Before mounting the module on a DIN rail, close the DIN rail latch. Press the DIN rail mounting area of the module against the DIN rail. The latch will momentarily open and lock into place.

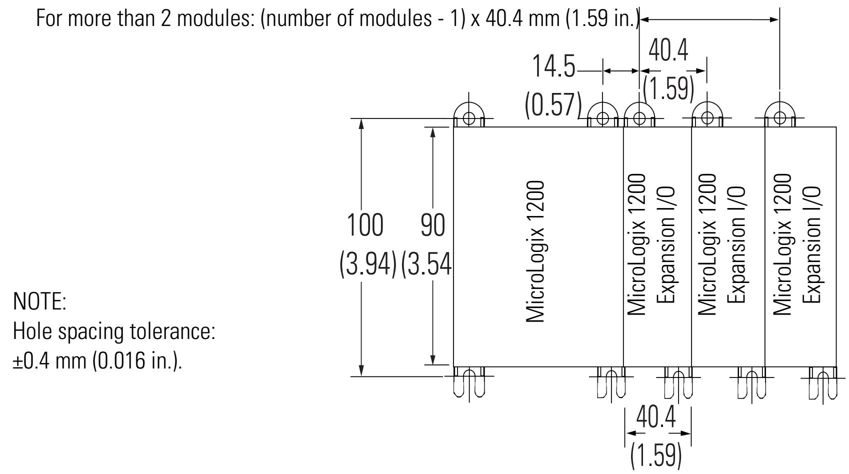
Use DIN rail end anchors (Allen-Bradley part number 1492-EA35 or 1492-EAH35) for environments with vibration or shock concerns.



TIP For environments with extreme vibration and shock concerns, use the panel mounting method described below, instead of DIN rail mounting.

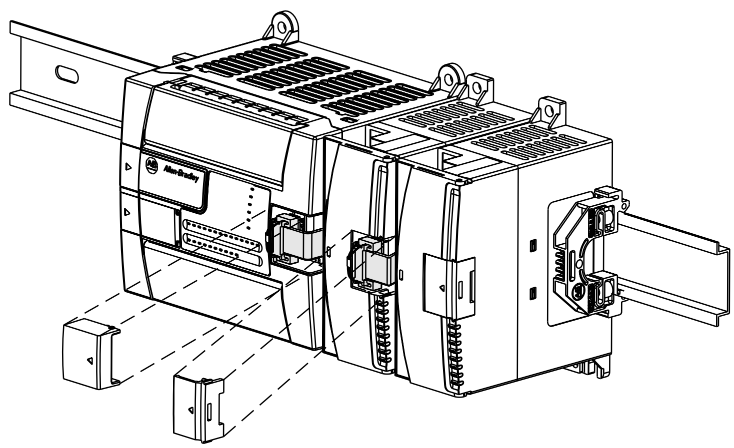
Panel Mounting

Use the dimensional template shown below to mount the module. The preferred mounting method is to use two M4 or #8 panhead screws per module. M3.5 or #6 panhead screws may also be used, but a washer may be needed to ensure a good ground contact. Mounting screws are required on every module.



System Assembly

The expansion I/O module is attached to the controller or another I/O module by means of a ribbon cable *after* mounting as shown below.



IMPORTANT Use the pull loop on the connector to disconnect modules. Do not pull on the ribbon cable.

WARNING

EXPLOSION HAZARD

- In Class I, Division 2 applications, the bus connector must be fully seated and the bus connector cover must be snapped in place.
- In Class I, Division 2 applications, all modules must be mounted in direct contact with each other as shown on page 2-1. If DIN rail mounting is used, an end stop must be installed ahead of the controller and after the last 1762 I/O module.

Field Wiring Connections

System Wiring Guidelines

Consider the following when wiring your system:

General

- This product is intended to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the module's mounting tabs or DIN rail (if used) are not required unless the mounting surface cannot be grounded.
- Channels are isolated from one another by ±10V dc maximum.
- Do not use the modules NC terminals as connection points.
- Route field wiring away from any other wiring and as far as possible from sources of electrical noise, such as motors, transformers, contactors, and ac devices. As a general rule, allow at least 15.2 cm (6 in.) of separation for every 120V of power.
- Routing field wiring in a grounded conduit can reduce electrical noise.
- If field wiring must cross ac or power cables, ensure that they cross at right angles.
- To ensure optimum accuracy, limit overall cable impedance by keeping your cable as short as possible. Locate the I/O system as close to your sensors or actuators as your application will permit.
- Tighten terminal screws with care. Excessive tightening can strip a screw.

Shield Grounding

- Use Belden shielded, twisted-pair wire to ensure proper operation and high immunity to electrical noise. Refer to the following table and the RTD Wiring Considerations below.

Configuration	Recommended Cable(1)
2-wire	Belden™ 9501 or equivalent
3-wire less than 30.48 m (100ft.)	Belden™ 9533 or equivalent
3-wire greater than 30.48 m (100 ft.) or high humidity conditions	Belden™ 83503 or equivalent

(1) For additional information, see page A-4.

- Under normal conditions, the drain wire and shield junction should be connected to earth ground, via a panel or DIN rail mounting screw at the 1762-IR4 module end.

- Keep shield connection to ground as short as possible.
- If noise persists for a device, try grounding the opposite end of the cable. (You can only ground one end at a time.)
- Refer to *Industrial Automation Wiring and Grounding Guidelines*, Allen-Bradley publication 1770-4.1, for additional information.

RTD Wiring Considerations

Since the operating principle of the RTD module is based on the measurement of resistance, take special care when selecting your input cable. For 2-wire or 3-wire configurations, select a cable that has a consistent impedance throughout its entire length. See Cable Specifications on page A-4.

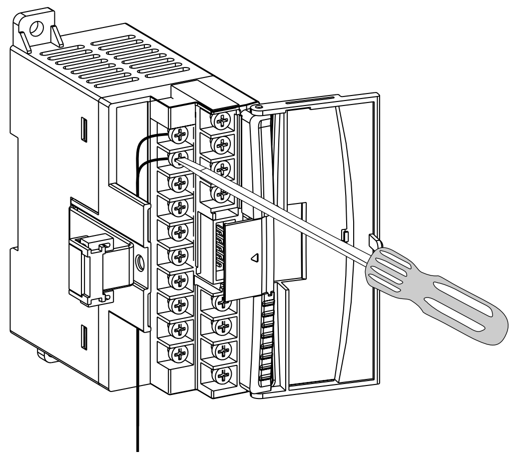
IMPORTANT	The RTD module requires three wires to compensate for lead resistance error. We recommend that you do not use 2-wire RTDs if long cable runs are required, as it reduces the accuracy of the system. However, if a two-wire configuration is required, reduce the effect of the lead wire resistance by using a lower gauge wire for the cable (for example, use AWG #16 instead of AWG #24). The module's terminal block accepts two AWG #14 gauge wires.

When using a 3-wire configuration, the module compensates for resistance error due to lead wire length. For example, in a 3-wire configuration, the module reads the resistance due to the length of one of the wires and assumes that the resistance of the other wire is equal. If the resistances of the individual lead wires are much different, an error may exist. The closer the resistance values are to each other, the greater the amount of error that is eliminated.

IMPORTANT	To ensure temperature or resistance value accuracy, the resistance difference of the cable lead wires must be equal to or less than 0.01Ω.

To insure that the lead values match as closely as possible:

- Keep lead resistance as small as possible and less than 25Ω.
- Use quality cable that has a small tolerance impedance rating.
- Use a heavy-gauge lead wire which has less resistance per foot.



Wiring the Finger-Safe Terminal Block

ATTENTION

Be careful when stripping wires. Wire fragments that fall into a module could cause damage when power is applied. Once wiring is complete, ensure the module is free of all metal fragments.

When wiring the terminal block, keep the finger-safe cover in place.

1. Route the wire under the terminal pressure plate. You can use the stripped end of the wire or a spade lug. The terminals will accept a 6.35 mm (0.25 in.) spade lug.

2. Tighten the terminal screw making sure the pressure plate secures the wire. Recommended torque when tightening terminal screws is 0.904 Nm (8 in-lbs).

3. After wiring is complete, remove the debris shield.

TIP

If you need to remove the finger-safe cover, insert a screw driver into one of the square wiring holes and gently pry the cover off. If you wire the terminal block with the finger-safe cover removed, you will not be able to put it back on the terminal block because the wires will be in the way.

Wire Size and Terminal Screw Torque

Each terminal accepts up to two wires with the following restrictions:

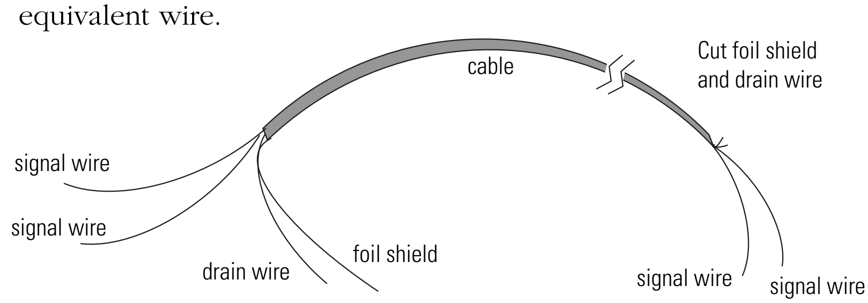
Wire Type		Wire Size	Terminal Screw Torque
Solid	Cu-90°C (194°F)	#14 to #22 AWG	0.904 Nm (8 in-lbs)
Stranded	Cu-90°C (194°F)	#16 to #22 AWG	0.904 Nm (8 in-lbs)

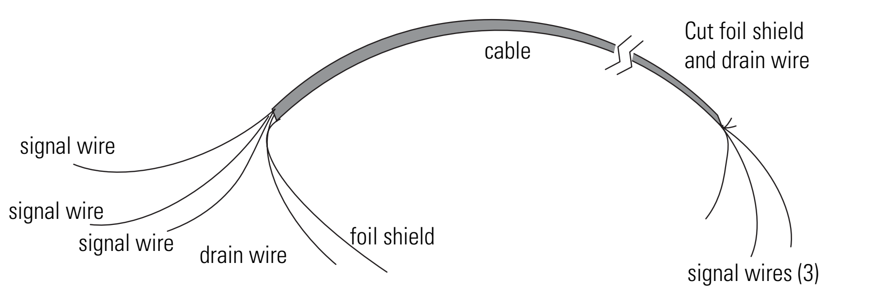
Wiring Input Devices to the Module

ATTENTION

To prevent shock hazard, care should be taken when wiring the module to analog signal sources. Before wiring any module, disconnect power from the system power supply and from any other source to the module.

After the module is properly installed, follow the wiring procedure below and the RTD and potentiometer wiring diagrams on pages 2-12 through 2-15. To ensure proper operation and high immunity to electrical noise, always use Belden™ shielded, twisted-pair or equivalent wire.





To wire your module follow these steps:

1. At each end of the cable, strip some casing to expose the individual wires.

2. Trim the signal wires to 2-inch (5 cm) lengths. Strip about 3/16 inch (5 mm) of insulation away to expose the end of the wire.

ATTENTION Be careful when stripping wires. Wire fragments that fall into a module could cause damage at power up.

3. At the module end of the cable, twist the drain wire and foil shield together, bend them away from the cable, and apply shrink wrap. Then earth ground via a panel or DIN rail mounting screw at the end of the module. Keep the length of the drain wire as short at possible.

4. At the other end of the cable, cut the drain wire and foil shield back to the cable and apply shrink wrap.

5. Connect the signal wires to the terminal block as described for each type of input. See Wiring RTDs on page 2-12 or Wiring Resistance Devices (Potentiometers) on page 2-14.

6. Connect the other end of the cable to the analog input device.

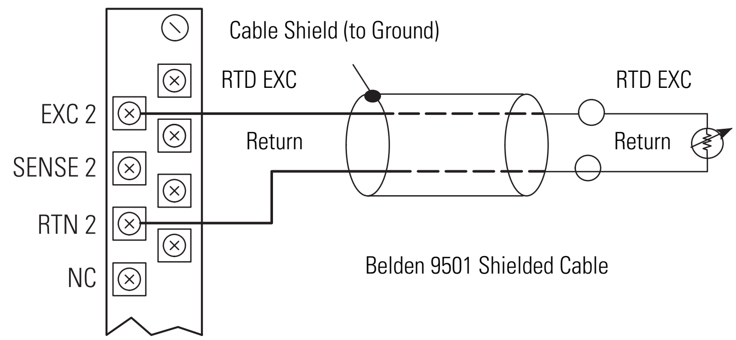
7. Repeat steps 1 through 6 for each channel on the module.

Wiring RTDs

Three types of RTDs can be connected to the 1762-IR4 module:

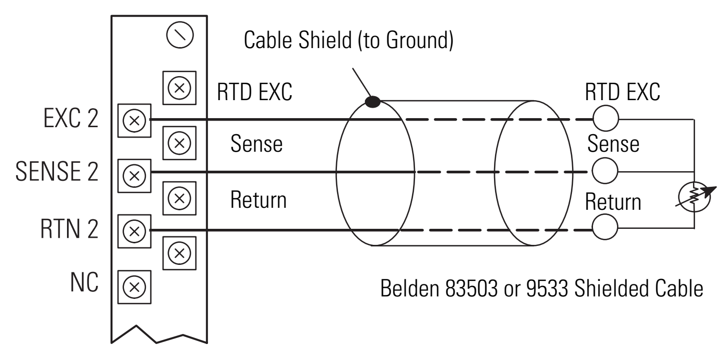
- 2-wire RTD, which is composed of an RTD EXC (excitation) lead wire and a RTN (return) lead wire
- 3-wire RTD, which is composed of a Sense and 2 RTD lead wires (RTD EXC and RTN)
- 4-wire RTD, which is composed of a Sense and 2 RTD lead wires (RTD EXC and RTN). The second sense wire from the 4-wire RTD is left open.

2-Wire RTD Configuration

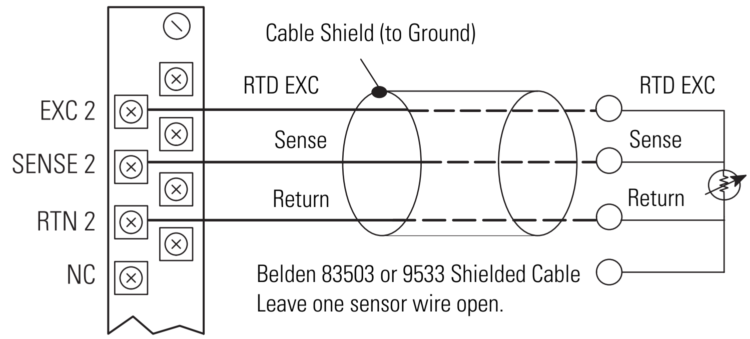


IMPORTANT Using 2-wire configurations does not permit the module to compensate for resistance error due to lead wire length. The resulting analog data includes the effect of this uncompensated lead wire resistance. The module continues to place the uncompensated analog data in the input data file, but the open-circuit status bit (OCx) is set in word 4 of the input data file for any enabled channel using a 2-wire configuration. These status bits may be used in the control program to indicate that the analog data includes error due to uncompensated lead wires. See page 3-4 for a detailed discussion of the open-circuit status bits.

3-Wire RTD Configuration



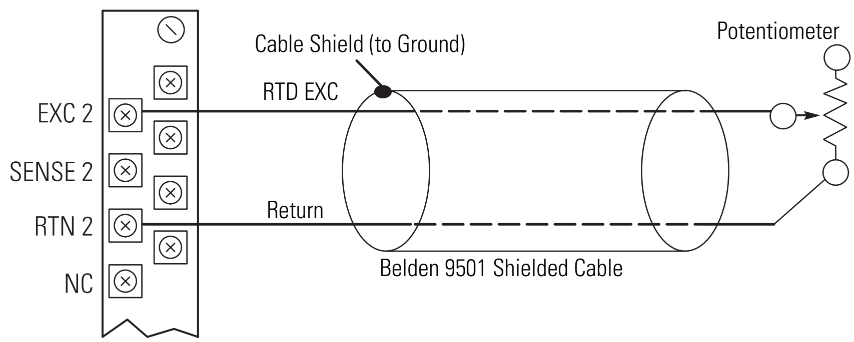
4-Wire RTD Configuration

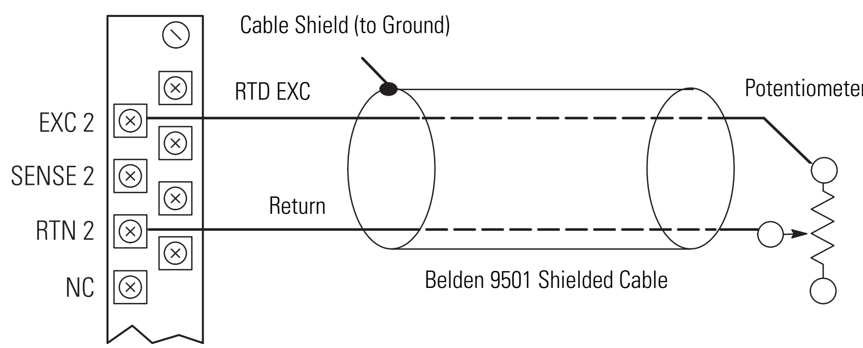


Wiring Resistance Devices (Potentiometers)

Potentiometer wiring requires the same type of cable as that for the RTDs described on page 2-9. Potentiometers can be connected to the module as a 2-wire or 3-wire connection as shown on page 2-14.

2-Wire Potentiometer Interconnection

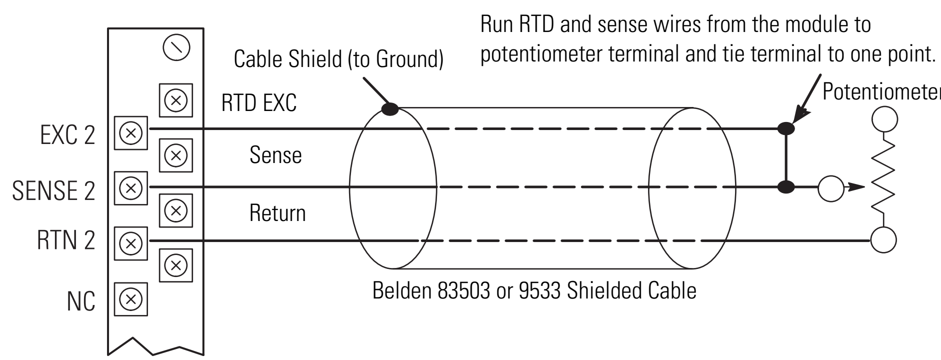


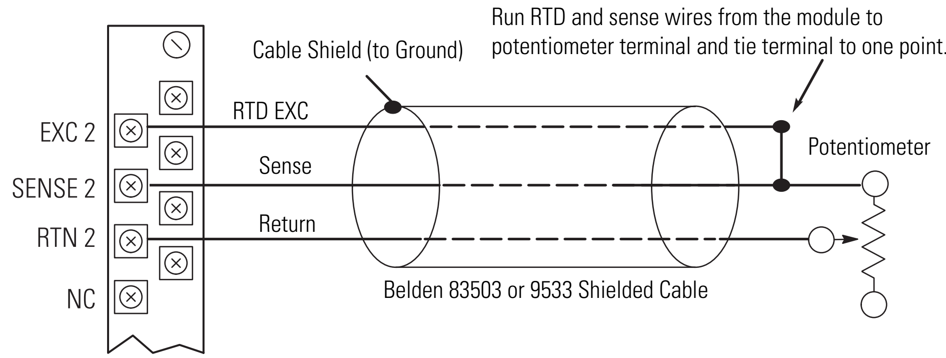


TIP	The potentiometer wiper arm can be connected to either the EXC or return terminal depending on whether you want increasing or decreasing resistance.

IMPORTANT Using 2-wire configurations does not permit the module to compensate for resistance error due to lead wire length. The resulting analog data includes the effect of this uncompensated lead wire resistance. The module continues to place the uncompensated analog data in the input data file, but the open-circuit status bit (OCx) is set in word 4 of the input data file for any enabled channel using a 2-wire configuration. These status bits may be used in the control program to indicate that the analog data includes error due to uncompensated lead wires. See page 3-4 for a detailed discussion of the open-circuit status bits.

3-Wire Potentiometer Interconnection





TIP The potentiometer wiper arm can be connected to either the EXC or return terminal depending on whether you want increasing or decreasing resistance.

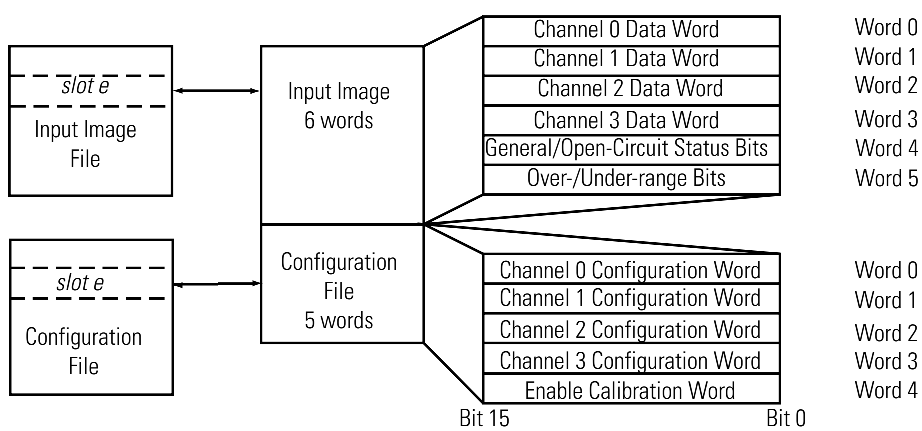
Module Data, Status, and Channel Configuration

After installing the 1762-IR4 RTD/resistance input module, you must configure it for operation, usually using the programming software compatible with the controller (for example, RSLogix 500™). Once configuration is complete and reflected in ladder logic, you will need to get the module up and running and then verify its operation. This chapter includes information on the following:

- module memory map
- accessing input image file data
- configuring channels
- configuring periodic calibration
- preparing ladder logic to reflect the configuration
- running the module
- verifying the configuration

Module Memory Map

The module uses six input words for data and status bits (input image), and five configuration words.



Input Image

The input image file represents data words and status words. Input words 0 through 3 hold the input data that represents the value of the analog inputs for channels 0 through 3. These data words are valid only when the channel is enabled and there are no errors. Input words 4 and 5 hold the status bits. To receive valid status information, the channel must be enabled.

Configuration File

The configuration file contains information that you use to define the way a specific channel functions. The configuration file is explained in more detail in Configuration Data File on page 3-6.

TIP Not all controllers support program access to the configuration file. Refer to your controller's user manual.

Accessing Input Image File Data

Six words of the processor input image table are reserved for the module's image data. You can access the information in the input image file using the programming software configuration screen. For more information on configuration using MicroLogix 1200 and RSLogix 500, see Appendix B.

Input Data File

The input data table allows you to access RTD input module read data for use in the control program, via word and bit access. The data table structure is shown in table below.

Table 3.1 Input Data Table

Word/Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	RTD/Resistance Input Data Channel 0															
1	RTD/Resistance Input Data Channel 1															
2	RTD/Resistance Input Data Channel 2															
3	RTD/Resistance Input Data Channel 3															
4	Reserved				OC3	OC2	OC1	OC0	Reserved				S3	S2	S1	S0
5	U0	O0	U1	O1	U2	O2	U3	O3	Reserved							

Input Data Values

Data words 0 through 3 correspond to channels 0 through 3 and contain the converted analog input data from the input device.

TIP

Status bits for a particular channel reflect the configuration settings for that channel. To receive valid status, the channel must be enabled and the module must have stored a valid configuration word for that channel.

General Status Flag Bits (S0 to S3)

Bits S0 through S3 of Word 3 contain the general status information for channels 0 through 3, respectively. This bit is set (1) when an error (over- or under-range, short-circuit, open-circuit, or input data not valid) exists for that channel. The error conditions of the General Status bits are logically ORed. Therefore, the user control program determines which condition is setting the general status bit by viewing the following bits: open-circuit, over-range, or under-range. The data not valid condition is described on the following page.

Input Data Not Valid Condition

The general status bits S0 to S3 also indicate whether or not the input data for a particular channel, 0 through 3, is being properly converted (valid) by the module. This “invalid data” condition can occur (bit set) when the download of a new configuration to a channel is accepted by the module (proper configuration) but before the A/D converter can provide valid (properly configured) data to the MicroLogix 1200 controller. The following information highlights the bit operation of the Data Not Valid condition.

1. The default and module power-up bit condition is reset (0).

2. The bit condition is set (1) when a new configuration is received and determined valid by the module. The set (1) bit condition remains until the module begins converting analog data for the previously accepted configuration. When conversion is complete, the bit condition is reset (0) by the module. The amount of time it takes for the module to begin the conversion process depends on the number of channels being configured and the amount of configuration data downloaded by the controller.

   TIP If the new configuration is invalid, the bit function remains reset (0) and the module posts a configuration error. See Configuration Errors on page 4-6.

3. If A/D hardware errors prevent the conversion process from taking place, the bit condition is set (1).

Open-Circuit Flag Bits (OC0 to OC3)

Bits OC0 through OC3 of word 4 contain open-circuit error information for channels 0 through 3, respectively. For an RTD input, the bits indicate either an open-circuit or short-circuit condition when set (1). For a resistance input, the bits indicate an open-circuit when set (1).

TIP Short-circuit detection for direct resistance inputs is not indicated because 0 is a valid number.

Over-Range Flag Bits (O0 to O3)

Over-range bits for channels 0 through 3 are contained in word 5, even-numbered bits. They apply to all input types. When set (1), the over-range flag bit indicates an RTD temperature that is greater than the maximum allowed temperature or a resistance input that is greater than the maximum allowed resistance for the module. The module automatically resets (0) the bit when the data value is again within the normal operating range.

Under-Range Flag Bits (U0 to U3)

Under-range bits for channels 0 through 3 are contained in word 5, odd-numbered bits. They apply only to RTD input types. When set (1), the under-range flag bit indicates an RTD temperature that is less than the minimum allowed temperature. The module automatically resets (0) the bit when the data value is again within the normal operating range.

TIP There is no under-range error for a direct resistance input, because 0 is a valid number.

Configuring Channels

After module installation, you must configure operation details, such as RTD type, temperature units, etc., for each channel. Channel configuration data for the module is stored in the controller configuration file, which is both readable and writable.

Configuration Data File

The configuration data file is shown below. Bit definitions are provided in Channel Configuration on page 3-7. Detailed definitions of each of the configuration parameters follows the table.

TIP

Normal channel configuration is done using programming software. In that case, it is not necessary to know the meaning of the bit location. However, some systems allow configuration to be changed by the control program. Refer to your controller's documentation for details.

The default configuration of the table is all zeros, which yields the following.

Table 3.2 Default Configuration

Parameter	Default Setting
Channel Enable/Disable	Disable
Data Format	Raw/Proportional
Input/Sensor Type	100Ω Platinum 385
Temperature Units/Mode	°C (not applicable with Raw/Proportional)
Open/Broken Circuit Response	Upscale
Cyclic Lead Compensation	Enable
Excitation Current	1.0 mA
Input FIlter Frequency	60 Hz

The following table shows the basic arrangement of the configuration data file.

Table 3.3 Configuration Data File

Word/ Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Enable/ Disable Channel 0	Data Format Channel 0			Input/Sensor Type Channel 0				Temperature Units/Mode Channel 0	Open/ Broken Circuit Response Channel 0		Cyclic Lead Compensation Channel 0	Excitation Current Channel 0	Filter Frequency Channel 0		
1	Enable/ Disable Channel 1	Data Format Channel 1			Input/Sensor Type Channel 1				Temperature Units/Mode Channel 1	Open/ Broken Circuit Response Channel 1		Cyclic Lead Compensation Channel 1	Excitation Current Channel 1	Filter Frequency Channel 1		
2	Enable/ Disable Channel 2	Data Format Channel 2			Input/Sensor Type Channel 2				Temperature Units/Mode Channel 2	Open/ Broken Circuit Response Channel 2		Cyclic Lead Compensation Channel 2	Excitation Current Channel 2	Filter Frequency Channel 2		
3	Enable/ Disable Channel 3	Data Format Channel 3			Input/Sensor Type Channel 3				Temperature Units/Mode Channel 3	Open/ Broken Circuit Response Channel 3		Cyclic Lead Compensation Channel 3	Excitation Current Channel 3	Filter Frequency Channel 3		
4	Not Used															Enable/Disable Cyclic Calibration(1)

(1) When enabled, an autocalibration cycle is performed on all enabled channels every 5 minutes.

Channel Configuration

Words 0 to 3 of the configuration file allow you to change the parameters of each channel independently. For example, word 0 corresponds to channel 0, word 1 to channel 1, etc. The functional arrangement of the bits for one word is shown in the table on page 3-8.

Table 3.4 Channel Configuration Bit Definitions

To Select		Make these bit settings																
		15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	**Decimals**
Filter Frequency	10 Hz														1	1	0	6
	60 Hz														0	0	0	0
	50 Hz														0	0	1	1
	250Hz														0	1	1	3
	500 Hz														1	0	0	4
	1 kHz														1	0	1	5
Excitation Current	1.0 mA													0				0
	0.5 mA													1				8
Cyclic Lead Compensation	Enable												0					0
	Disable												1					16
Open/Broken Circuit Response	Upscale										0	0						0
	Downscale										0	1						32
	Last State										1	0						64
	Zero										1	1						96
Temperature Units/Mode(1)	°C									0								0
	°F									1								128
Input/Sensor Type	100Ω Platinum 385					0	0	0	0									0
	200Ω Platinum 385					0	0	0	1									256
	500Ω Platinum 385					0	0	1	0									512
	1000Ω Platinum 385(2)					0	0	1	1									768
	100Ω Platinum 3916					0	1	0	0									1024
	200Ω Platinum 3916					0	1	0	1									1280
	500Ω Platinum 3916					0	1	1	0									1536
	1000Ω Platinum 3916(2)					0	1	1	1									1792
	10 Copper 426(3)					1	0	0	0									2048
	120 Nickel 618					1	0	0	1									2304
	120 Nickel 672					1	0	1	0									2560
	604 Nickel-Iron 518					1	0	1	1									2846
	150 Ω					1	1	0	0									3072
	500 Ω					1	1	0	1									3328
	1000 Ω					1	1	1	0									3584
	3000Ω(2)					1	1	1	1									3840
Data Format	Raw/Proportional		0	0	0													0
	Engineering Units		0	0	1													4096
	Engr. Units X 10		1	0	0													16384
	Scaled-for-PID		0	1	0													8192
	Percent Range		0	1	1													12288
Enable/Disable Channel	Enable	1																-32768
	Disable	0																0

(1) Ignored for a resistance device input.
(2) Valid only with the 0.5 mA excitation current.
(3) Valid only with the 1.0 mA excitation current.

Enabling or Disabling a Channel (Bit 15)

Bit 15 enables or disables each of the six channels individually. The module only scans those channels that are enabled. Enabling a channel forces it to be recalibrated before it measures input data. Turning a channel off results in the channel data being set to zero.

TIP When a channel is not enabled, the A/D converter provides no input to the controller. This speeds up the system response of the active channels.

The configuration default is to disable each input channel to maximize module performance.

Selecting Data Format (Bits 12 to 14)

Bits 12 through 14 of the channel configuration word are used to indicate the input data format. You may choose any of the following formats:

- raw/proportional
- engineering units x 1
- engineering units x 10
- scaled for PID
- percent of full scale

TIP The engineering units data formats represent real temperature or resistance engineering units provided by the module. The raw/proportional counts, scaled-for-PID, and percent of full scale data formats The raw/proportional counts, scaled-for-PID and percent of full-scale data formats may yield the highest effective resolutions, but may also require that you convert channel data to real engineering units in your control program.

Table 3.5 Data Formats for RTD Temperature Ranges for 0.5 and 1.0 mA Excitation Current

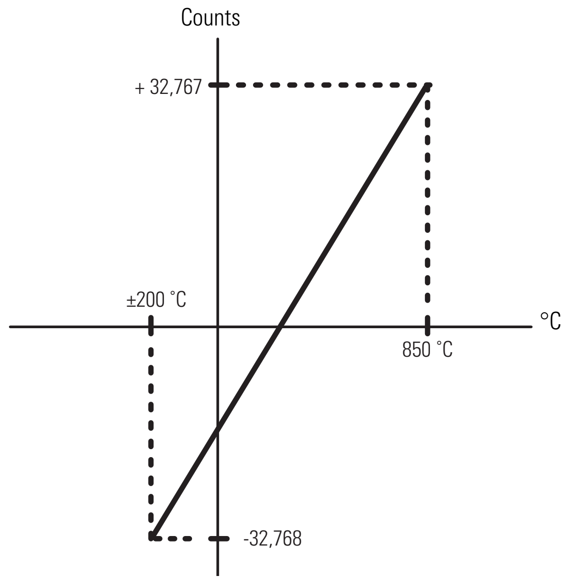
RTD Input Type	Data Format						
	Engineering Units x1		Engineering Units x10		Scaled-for-PID	Proportional Counts	Percent of Full Scale
	0.1°C	0.1°F	1.0°C	1.0°F			
100Ω Platinum 385	-2000 to +8500	-3280 to +15620	-200 to +850	-328 to +1562	0 to 16383	-32768 to +32767	0 to +10000
200Ω Platinum 385	-2000 to +8500	-3280 to +15620	-200 to +850	-328 to +1562			
500Ω Platinum 385	-2000 to +8500	-3280 to +15620	-200 to +850	-328 to +1562			
1000Ω Platinum 385	-2000 to +8500	-3280 to +15620	-200 to +850	-328 to +1562			
100Ω Platinum 3916	-2000 to +6300	-3280 to +11660	-200 to +630	-328 to +1166			
200Ω Platinum 3916	-2000 to +6300	-3280 to +11660	-200 to +630	-328 to +1166			
500Ω Platinum 3916	-2000 to +6300	-3280 to +11660	-200 to +630	-328 to +1166			
1000Ω Platinum 3916	-2000 to +6300	-3280 to +11660	-200 to +630	-328 to +1166			
10Ω Copper 426	-1000 to +2600	-1480 to +5000	+100 to +260	-148 to +500			
120Ω Nickel 618	-1000 to +2600	-1480 to +5000	-100 to +260	-148 to +500			
120Ω Nickel 672	-800 to +2600	-1120 to +5000	-80 to +260	-112 to +500			
604Ω Nickel Iron 518	-1000 to +2000	-3280 to +3920	-100 to +200	-328 to +392			

Raw/Proportional Data Format

The raw/proportional data format provides the greatest resolution of all the data formats. For this format, the value presented to the controller is proportional to the selected input. It is also scaled to the maximum data range allowed by the bit resolution of the A/D converter and selected filter frequency.

If you select the raw/proportional data format for a channel, the data word will be a linearized number between -32768 and +32767. The value -32768 corresponds to the lowest temperature value for an RTD or the lowest resistance value for a resistance device.

Figure 3.1 Linear Relationship Between Temperature and Proportional Counts



The value +32767 corresponds to the highest value for the device. For example, if a 100Ω platinum 385 RTD is selected, the lowest temperature of -200° C corresponds to -32768 counts. The highest temperature of 850° C corresponds to +32767 counts. See Determining Effective Resolution and Range on page 3-20.

Scaling Examples

EXAMPLE

Scaled-for-PID to Engineering Units x1

- input type = 200Ω Platinum RTD
- α = 0.00385°C
- range = -200 to +850°C S_{LOW} = -200°C S_{HIGH} = +850°C
- channel data = 3421(scaled-for-PID)

Engineering Units Equivalent = S_{LOW} + (S_{HIGH} - S_{LOW}) x (channel data/16383)]

Engineering Units Equivalent = -200°C + [(+850°C -(-200°C)) x (3421/16383)] = 19.25°C

EXAMPLE

Engineering Units x1 to Scaled-for-PID

- input type = 200Ω Platinum RTD
- α = 0.00385°C
- range = -200 to +850°C S_{LOW} = -200°C S_{HIGH} = +850°C
- desired channel temperature = 344°C (engineering units)

Scaled-for-PID Equivalent = 16383 x [(desired ch. temp. - S_{LOW})/(S_{HIGH} - S_{LOW})]

Scaled-for-PID Equivalent = 16383 x [(344°C - (-200°C))/(850°C - (-200°C))] = 8488

EXAMPLE

Proportional Counts to Engineering Units x1

- input type = 1000Ω potentiometer
- range = 0 to 1000Ω S_{LOW} = 0Ω S_{HIGH} = 1000Ω
- channel data = 21567 (proportional counts)

Engineering Units Equivalent =
S_{LOW} + {(S_{HIGH} - S_{LOW}) x [(ch. data + 32768)/65536]}

Engineering Units Equivalent =
0 + {(1000 - 0) x [(21567 + 32768)/65536]} = 829Ω

EXAMPLE

Engineering Units x1 to Proportional Counts

- input type = 3000Ω potentiometer
- range = 0 to 3000Ω S_{LOW} = 0Ω S_{HIGH} = 3000Ω
- desired channel resistance = 1809Ω (engineering units x 1)

Prop. Counts Equivalent =
{65536 x [(ch. resistance - S_{LOW})/(S_{HIGH} - S_{LOW})]} - 32768

Proportional Counts Equivalent =
{65536 x [(1809Ω - 0) / (3000 –0)] } –32768 = 6750

Engineering Units x 1 Data Format

If you select engineering units x 1 as the data format for an RTD input, the module scales input data to the actual temperature values for the selected RTD type per RTD standard. It expresses temperatures in 0.1° C units. For resistance inputs, the module expresses resistance in 0.1Ω units, for all ranges except the 150Ω range. For the latter, resistance is expressed in 0.01Ω units.

TIP Use the engineering units x 10 setting to produce temperature readings in whole degrees Celsius or Fahrenheit. See Engineering Units x 10 Data Format below.

The resolution of the engineering units x 1 format is dependent on the range selected and the filter selected. See Determining Effective Resolution and Range on page 3-20.

Engineering Units x 10 Data Format

For the engineering units x 10 data format for an RTD input, the module scales input data to the actual temperature values for the selected RTD type per RTD standard. With this format, the module expresses temperatures in 1° C units. For resistance inputs, the module expresses resistance in 1Ω units, for all ranges except the 150Ω range. For the latter, resistance is expressed in 0.1Ω units.

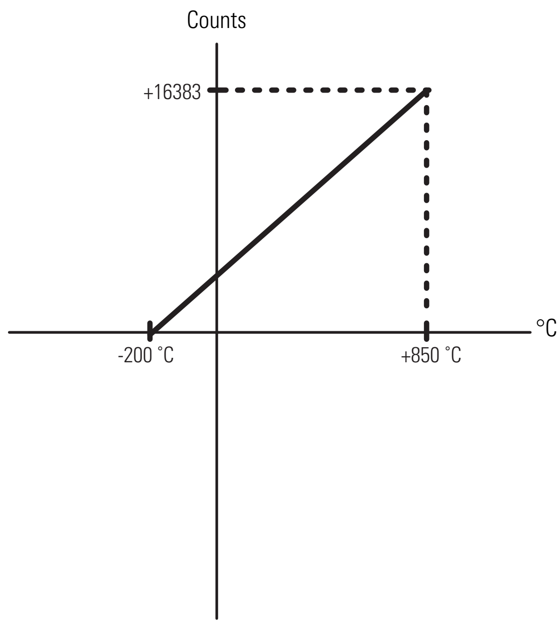
The resolution of the engineering units x 10 format is dependent on the range selected and the filter selected. See Determining Effective Resolution and Range on page 3-20.

Scaled-for-PID Data Format

If you select the scaled-for-PID data format, the module presents to the controller a signed integer representing the input signal range proportional to the selected input type. The integer value is the same for RTD and resistance input types.

To obtain the value, the module scales the input signal range to a linearized 0 to 16383 range, which is standard to the PID algorithm for the MicroLogix, SLC, and PLC controllers. The 0 value corresponds to the lowest temperature or resistance value, while 16383 corresponds to the highest value. For example, if a 100Ω platinum 385 RTD is selected, the lowest temperature for the RTD, -200° C, corresponds to 0. The highest temperature, 850° C, corresponds to 16383.

Linear Relationship Between Temperature and PID Counts



The amount over and under user range (full-scale range -410 to +16793) is also included in the signed integer provided to the controller. Allen-Bradley controllers, such as the MicroLogix 1500, use this range in their PID equations. See Determining Effective Resolution and Range on page 3-20.

Percent of Full Scale Data Format

With the percent of full scale data format, the module presents input data to the user as a percent of the user-specified range. For example, for a 100Ω platinum 385 RTD, the range -200×C to 850×C is represented as 0 percent to 100 percent. See Determining Effective Resolution and Range on page 3-20.

Selecting Input/Sensor Type (Bits 8 to 11)

You can set bits 8 through 11 in the channel configuration word to indicate the type of input sensor, for example, 100Ω platinum 385 RTD. Each channel can be configured for any input type. The valid input types and bit settings are listed in the channel configuration table on page 3-7.

Selecting Temperature Units/Mode (Bit 7)

The module supports two different linearized, scaled temperature ranges for RTDs, degrees Celsius (°C) and degrees Fahrenheit (°F). You can select the type that is appropriate for your application by setting bit 7 in the channel configuration word. Bit 7 is ignored for resistance input types or when raw/proportional, scaled-for-PID, or percent data formats are used.

Selecting Open-Circuit Response (Bits 5 and 6)

Broken inputs for the module include open-circuit and short-circuit conditions. An open-circuit occurs when the module's maximum input voltage is reached. This can happen if the wire is cut or disconnected from the terminal block. The module can encounter an open-circuit for any RTD or resistance input.

A short-circuit occurs when the calculated lead wire compensated resistance is less than 3Ω . The module can only report a short-circuit for an RTD.

Use bits 5 and 6 of channel configuration word to define the state of the channel data word when a broken input condition is detected for the corresponding channel. When it detects an open circuit or a short circuit, the module overrides the actual input data with the value that you specify.

Table 3.6 Open/Broken Circuit Response Definitions

Open/Broken Circuit Value	Response Definition
Upscale	Sets input to full upper scale value of channel data word. The full-scale value is determined by the selected input type, data format, and scaling.
Downscale	Sets input to full lower scale value of channel data word. The low scale value is determined by the selected input type, data format, and scaling.
Last State	Sets input to last input value.
Zero	Sets input to 0 to force the channel data word to 0.

Selecting Cyclic Lead Compensation (Bit 4)

For each channel, the module measures lead resistance in one of two ways. Set bit 4 to 0 to *enable* measurement and compensation of lead resistance every five minutes. One channel is measured per module update to limit the impact to channel throughput. You can also implement a lead wire calibration cycle any time, at your command, by enabling and then disabling this bit in your control program. Regardless of the state of bit 4, lead wire compensation occurs automatically on a system mode change from Program-to-Run or if any online configuration change is made to a channel.

Selecting Excitation Current (Bit 3)

The module is capable of exciting each individual RTD/resistance device with either 0.5 mA or 1.0 mA of current. Setting bit 3 to 0 provides 1.0 mA, while a setting of 1 provides 0.5 mA.

The 0.5 mA excitation current is recommended for use with 1000Ω RTDs and 3000Ω direct resistance inputs. An excitation current of 1.0 mA is recommended for all other RTDs except the 1000Ω devices, and all other direct resistance devices except the 3000Ω devices. Refer to the input device literature for the manufacturer's recommendations.

TIP A lower excitation current reduces error due to RTD self-heating, but provides a lower signal-to-noise ratio. See the manufacturer's recommendations for your particular RTD.

Setting Filter Frequency (Bits 0 to 2)

The module supports filter selections corresponding to filter frequencies of 10 Hz, 50 Hz, 60 Hz, 250 Hz, 500 Hz, and 1 kHz. Your filter frequency selection is determined by the desired range for the input type, and the required effective resolution, which indicates the number of bits in the channel configuration word that do not vary due to noise. Also consider the required module update time when choosing a filter frequency. For example, the 10 Hz filter provides the greatest attenuation of 50 and 60 Hz noise and the greatest resolution, but also provides the slowest response speed.

The choice that you make for filter frequency will affect:

- noise rejection characteristics for module input
- channel step response
- channel cutoff frequency
- module autocalibration
- effective resolution
- module update time

Effects of Filter Frequency on Noise Rejection

The filter frequency that you choose for a channel determines the amount of noise rejection for the inputs. A smaller filter frequency (e.g. 10Hz) provides the best noise rejection and increases effective resolution, but also increases channel update time. A larger filter frequency (e.g. 1 kHz) provides lower noise rejection, but also decreases the channel update time and effective resolution.

When selecting a filter frequency, be sure to consider channel cutoff frequency and channel step response to obtain acceptable noise rejection. Choose a filter frequency so that your fastest-changing signal is below that of the filter's cutoff frequency.

Common mode noise rejection for the module is better than 110 dB at 50 Hz (50 Hz filter) and 60 Hz (60 Hz filter). The module performs well in the presence of common mode noise as long as the signals applied to the input terminals do not exceed the common mode voltage rating (±10V) of the module. Improper earth ground can be a source of common mode noise.

TIP Transducer power supply noise, transducer circuit noise, and process variable irregularities can also be sources of common mode noise.

Channel Step Response

Another module characteristic determined by filter frequency is channel step response, as shown in the following table. The step response is the time required for the analog input signal to reach 100 percent of its expected final value, given a full-scale step change in the input signal. Thus, if an input signal changes faster than the channel step response, a portion of that signal will be attenuated by the channel filter. The channel step response is calculated by a settling time of 3 x (1 / filter frequency).

Table 3.7 Filter Frequency vs. Channel Step Response

Filter Frequency	Step Response	Filter Frequency	Step Response
10 Hz	300 ms	250 Hz	12 ms
50 Hz	60 ms	500 Hz	6 ms
60 Hz	50 ms	1 kHz	3 ms

Channel Cutoff Frequency

The channel cutoff frequency (-3 dB) is the point on the input channel frequency response curve where frequency components of the input signal are passed with 3 dB of attenuation. The following table shows cutoff frequencies for the supported filters.

Table 3.8 Filter Frequency vs. Channel Cutoff Frequency

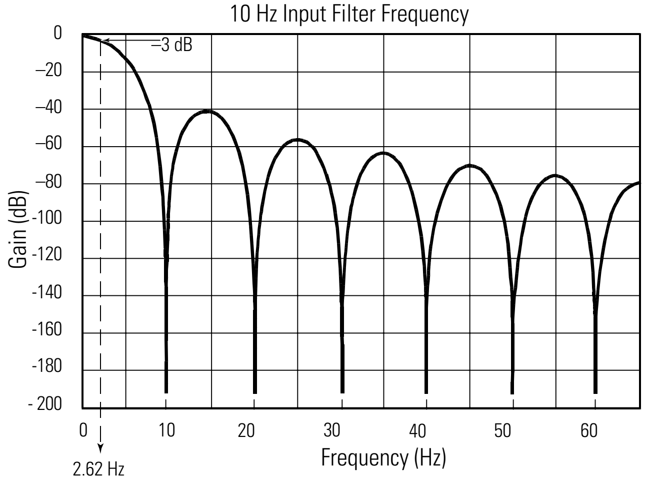
Filter Frequency	Channel Cutoff Frequency
10 Hz	2.62 Hz
50 Hz	13.1 Hz
60 Hz	15.7 Hz
250 Hz	65.5 Hz
500 Hz	131 Hz
1 kHz	262 Hz

All frequency components at or below the cutoff frequency are passed by the digital filter with less than 3 dB of attenuation. All frequency components above the cutoff frequency are increasingly attenuated, as shown in the graphs below for several of the input filter frequencies.

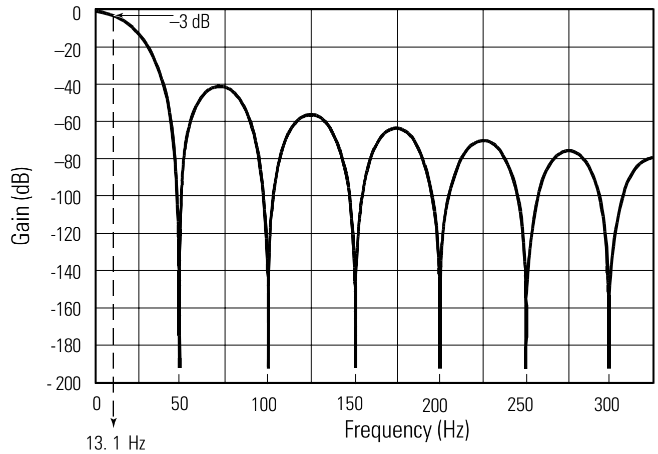
TIP Channel cutoff frequency should not be confused with channel update time. The cutoff frequency simply determines how the digital filter attenuates frequency components of the input signal. See Determining Module Update Time on page 3-27.

Frequency Response Graphs

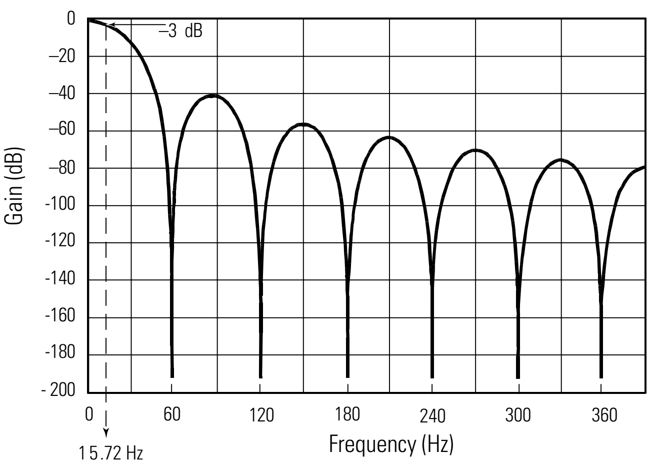
10 Hz Input Filter Frequency



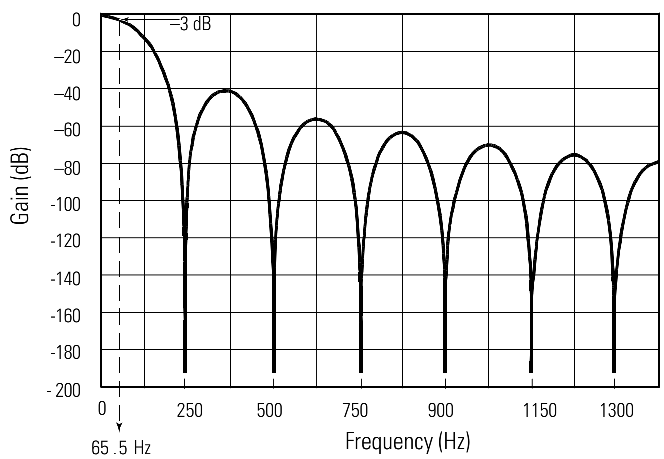
50 Hz Input Filter Frequency



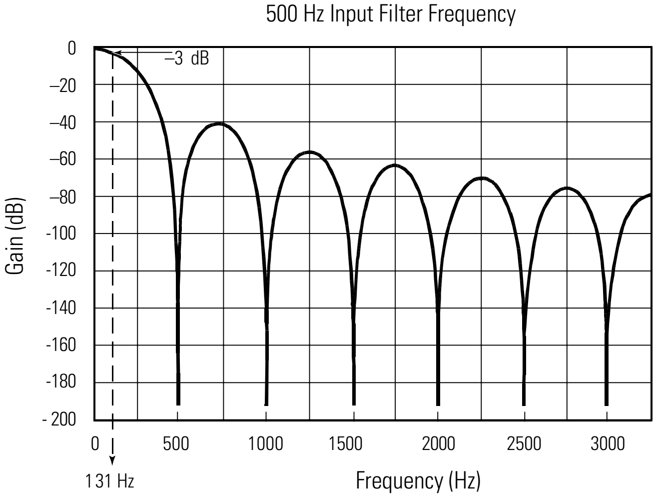
60 Hz Input Filter Frequency



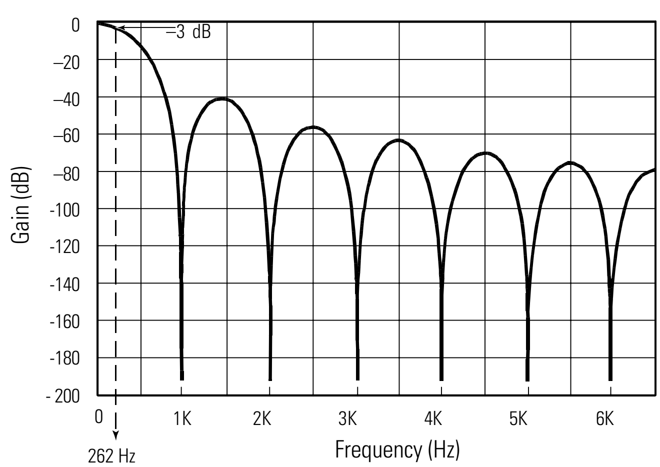
250 Hz Input Filter Frequency



500 Hz Input Filter Frequency



1 kHz Input Filter Frequency



Selecting Enable/Disable Cyclic Autocalibration (Word 4, Bit 0)

Configuration word 4, bit 0 allows you to configure the module to perform an autocalibration cycle of all enabled channels once every 5 minutes. Cyclic calibration functions to reduce offset and gain drift errors due to temperature changes within the module. Setting this bit to 1 disables cyclic calibration, the default (0) enables the autocalibration function. See Effects of Autocalibration on Accuracy on page 3-33.

TIP For systems that allow modifying the state of this bit, you can program the autocalibration cycle to occur whenever you desire via the ladder program, by cycling the bit from 0 to 1.

Determining Effective Resolution and Range

This section provides tables showing effective resolution and range for all possible input data types at each filter frequency. Look up your required resolution, range, and input type in the tables. Choose the frequency that most closely matches your requirements.

Table 3.9 Effective Resolution and Range for 10 Hz Filter Frequency

Input Type	Raw/Proportional Data Over Full Input Range			Engineering Units x 1 Over Full Range			Engineering Units x 10 Over Full Range			Scaled for PID Over Full Range			Percent of Full Scale 0 to 100%		
	Decimal Range	Resolution		Decimal Range	Resolution		Decimal Range	Resolution		Decimal Range	Resolution		Decimal Range	Resolution	
		°C	°F		°C	°F		°C	°F		°C	°F		°C	°F
100Ω Pt 385	±32767	0.112°C/ 7 counts	0.202°F/ 7 counts	-2000 to +8500	0.200°C/ 2 counts	0.360°F/ 2 counts	-200 to +850	1.0°C/1 count	1.8°F/ 1 count	0 to 16383	0.128°C/ 2 counts	0.231°F/ 2 counts	0 to 10000	0.210°C/2 counts	0.378°F/ 2 counts
200Ω Pt 385		0.112°C/ 7 counts	0.202°F/ 7 counts	-2000 to +8500	0.200°C/ 2 counts	0.360°F/ 2 counts	-200 to +850	1.0°C/1 count	1.8°F/ 1 count		0.128°C/ 2 counts	0.231°F/ 2 counts		0.210°C/2 counts	0.378°F/ 2 counts
500Ω Pt 385		0.096°C/ 6 counts	0.173°F/ 6 counts	-2000 to +8500	0.100°C/ 1 count	0.180°F/ 1 count	-200 to +850	1.0°C/1 count	1.8°F/ 1 count		0.128°C/ 2 counts	0.231°F/ 2 counts		0.105°C/1 count	0.189°F/ 1 count
1000Ω Pt 385		0.096°C/ 6 counts	0.173°F/ 6 counts	-2000 to +8500	0.100°C/ 1 count	0.180°F/ 1 count	-200 to +850	1.0°C/1 count	1.8°F/ 1 count		0.128°C/ 2 counts	0.231°F/ 2 counts		0.105°C/1 count	0.189°F/ 1 count
100Ω Pt 3916		0.114°C/ 9 counts	0.205°F/ 9 counts	-2000 to +6300	0.200°C/ 2 counts	0.360°F/ 2 counts	-200 to +630	1.0°C/1 count	1.8°F/ 1 count		0.152°C/ 3 counts	0.274°F/ 3 counts		0.166°C/2 counts	0.299°F/ 2 counts
200Ω Pt 3916		0.063°C/ 5 counts	0.114°F/ 5 counts	-2000 to +6300	0.100°C/ 1 count	0.180°F/ 1 count	-200 to +630	1.0°C/1 count	1.8°F/ 1 count		0.101°C/ 2 counts	0.182°F/ 2 counts		0.083°C/1 count	0.149°F/ 1 count
500Ω Pt 3916		0.101°C/ 8 counts	0.182°F/ 8 counts	-2000 to +6300	0.100°C/ 1 count	0.180°F/ 1 count	-200 to +630	1.0°C/1 count	1.8°F/ 1 count		0.101°C/ 2 counts	0.182°F/ 2 counts		0.166°C/2 counts	0.299°F/ 2 counts
1000Ω Pt 3916		0.101°C/ 8 counts	0.182°F/ 8 counts	-2000 to +6300	0.100°C/ 1 count	0.180°F/ 1 count	-200 to +630	1.0°C/1 count	1.8°F/ 1 count		0.101°C/ 2 counts	0.182°F/ 2 counts		0.166°C/2 counts	0.299°F/ 2 counts
10Ω Cu 426		7.690°C/ 1400 counts	13.843°F/ 1400 counts	-1000 to +2600	7.7° C/77 counts	13.8°F/ 77 counts	-100 to +260	8.0°C/8 counts	14.4°F/ 8 counts		7.690°C/ 350 counts	13.843°F/ 350 counts		7.703°C/ 214 counts	13.866°F/ 214 counts
120Ω Ni 618		0.055°C/ 10 counts	0.099°F/ 10 counts	-1000 to +2600	0.100° C/ 1 count	0.180°F/ 1 count	-100 to +260	1.0°C/1 count	1.8°F/ 1 count		0.066°C/ 3 counts	0.119°F/ 3 counts		0.072°C/2 counts	0.130°F/ 2 counts
120Ω Ni 672		0.042°C/ 8 counts	0.075°F/ 8 counts	-800 to +2600	0.100° C/ 1 count	0.180°F/ 1 count	-80 to +260	1.0°C/1 count	1.8°F/ 1 count		0.042°C/ 2 counts	0.075°F/ 2 counts		0.068°C/2 counts	0.122°F/ 2 counts
604Ω NiFe 518		0.060°C/ 11 counts	0.091°F/ 11 counts	-1000 to +2000	0.120° C/ 1 count	0.180°F/ 1 count	-100 to +200	1.0°C/1 count	1.8°F/ 1 count		0.066°C/ 3 counts	0.099°F/ 3 counts		0.072°C/2 counts	0.108°F/ 2 counts
150Ω		0.039Ω / 17 counts		0 to +15000	0.040Ω/ 4 counts		0 to +1500	0.100Ω/ 1 count			0.046Ω/ 5 counts			0.045Ω/ 3 counts	
500Ω		0.046Ω / 6 counts		0 to +5000	0.100Ω/ 1 count		0 to +500	1.00Ω/ 1 count			0.061Ω/ 2 counts			0.050Ω/ 1 count	
1000Ω		0.092Ω/ 6 counts		0 to +10000	0.100Ω/ 1 count		0 to +1000	1.00Ω/ 1 count			0.122Ω/ 2 counts			0.100Ω/ 1 count	
3000Ω		0.320Ω/ 7 counts		0 to +30000	0.400Ω/ 4 counts		0 to +3000	1.00Ω/ 1 count			0.366Ω/ 2 counts			0.600Ω/ 2 counts	

Table 3.10 Effective Resolution and Range for 50-60 Hz Filter Frequency

Input Type	Raw/Proportional Data Over Full Input Range			Engineering Units x 1 Over Full Range			Engineering Units x 10 Over Full Range			Scaled for PID Over Full Range			Percent of Full Scale 0 to 100%		
	Decimal Range	Resolution		Decimal Range	Resolution		Decimal Range	Resolution		Decimal Range	Resolution		Decimal Range	Resolution	
		°C	°F		°C	°F		°C	°F		°C	°F		°C	°F
100Ω Pt 385	±32767	0.224°C / 14 counts	0.404°F/ 14 counts	-2000 to +8500	0.3°C / 3 counts	0.540°F/ 3 counts	-200 to +850	1.0°C/ 1 count	1.8°F/ 1 count	0 to 16383	0.256°C/4 counts	0.461°F/ 4 counts	0 to 10000	0.315°C/ 3 counts	0.567°F/ 3 counts
200Ω Pt 385		0.112°C / 7 counts	0.202°F/ 7 counts	-2000 to +8500	0.2°C / 2 counts	0.360°F/ 2 counts	-200 to +850	1.0°C/ 1 count	1.8°F/ 1 count		0.128°C/ 2 counts	0.231°F/ 2 counts		0.210°C/ 2 counts	0.378°F/ 2 counts
500Ω Pt 385		0.176°C / 11 counts	0.317°F/ 11 counts	-2000 to +8500	0.2°C / 2 counts	0.360°F/ 2 counts	-200 to +850	1.0°C/ 1 count	1.8°F/ 1 count		0.192°C/ 3 counts	0.346°F/ 3 counts		0.210°C/ 2 counts	0.378°F/ 2 counts
1000Ω Pt 385		0.352°C / 22 counts	0.634°F/ 22 counts	-2000 to +8500	0.4°C / 4 counts	0.720°F/ 4 counts	-200 to +850	1.0°C/ 1 count	1.8°F/ 1 count		0.385°C/ 6 counts	0.692°F/ 6 counts		0.420°C/ 4 counts	0.756°F/ 4 counts
100Ω Pt 3916		0.114°C / 9 counts	0.205°F/ 9 counts	-2000 to +6300	0.2°C / 2 counts	0.360°F/ 2 counts	-200 to +630	1.0°C/ 1 count	1.8°F/ 1 count		0.152°C/ 3 counts	0.274°F/ 3 counts		0.166°C/ 2 counts	0.299°F/ 2 counts
200Ω Pt 3916		0.063°C / 5 counts	0.114°F/ 5 counts	-2000 to +6300	0.1°C / 1 count	0.18° C / 1 count	-200 to +630	1.0°C/ 1 count	1.8°F/ 1 count		0.101°C/ 2 counts	0.182°F/ 2 counts		0.083°C/ 1 count	0.149°F/ 1 count
500Ω Pt 3916		0.101°C / 8 counts	0.182°F/ 8 counts	-2000 to +6300	0.1°C / 1 counts	0.18°F / 1 counts	-200 to +630	1.0°C/ 1 count	1.8°F/ 1 count		0.101°C/ 2 counts	0.182°F/ 2 counts		0.166°C/ 2 counts	0.299°F/ 2 counts
1000Ω Pt 3916		0.101°C / 8 counts	0.182°F/ 8 counts	-2000 to +6300	0.1°C / 1 count	0.18°F / 1 count	-200 to +630	1.0°C/ 1 count	1.8°F/ 1 count		0.101°C/ 2 counts	0.182°F/ 2 counts		0.166°C/ 2 counts	0.299°F/ 2 counts
10Ω Cu 426		15.381°C / 2800 counts	27.686°F/ 2800 counts	-1000 to +2600	15.40°C / 154 counts	27.720°F/ 154 counts	-100 to +260	16.00°C/ 16 counts	28.80°F/ 16 counts		15.381°C /700 counts	27.686°F/ 700 counts		15.406°C/ 428 counts	27.732°F/ 428 counts
120Ω Ni 618		0.055°C / 10 counts	0.099°F/ 10 counts	-1000 to +2600	0.1°C / 1 count	0.18°F / 1 count	-100 to +260	1.0°C/ 1 count	1.8°F/ 1 count		0.066°C/ 3 counts	0.119°F/ 3 counts		0.072°C/ 2 counts	0.130°F/ 2 counts
120Ω Ni 672		0.042°C / 8 counts	0.075°F/ 8 counts	-800 to +2600	0.1°C / 1 count	0.18°F / 1 count	-80 to +260	1.0°C/ 1 count	1.8°F/ 1 count		0.042°C/ 2 counts	0.075°F/ 2 counts		0.068°C/ 2 counts	0.122°F/ 2 counts
604Ω NiFe 518		0.121°C / 22 counts	0.181°F/ 22 counts	-1000 to +2000	0.12°C / 1 count	0.18°F / 1 count	-100 to +200	1.2°C/ 1 counts	1.8°F/ 1 count		0.132°C/ 6 counts	0.198°F/ 6 counts		0.144°C/ 4 counts	0.216°F/ 4 counts
150Ω		0.153Ω/67 counts		0 to +15000	0.160Ω/ 16 counts		0 to +1500	0.2Ω/2 counts			0.156Ω/ 17 counts			0.165Ω/ 11 counts	
500Ω		0.046Ω/6 counts		0 to +5000	0.1Ω/ 1 count		0 to +500	1.0Ω/ 1 count			0.061Ω/ 2 count			0.050Ω/ 1 count	
1000Ω		0.092Ω/6 counts		0 to +10000	0.1Ω/ 1 count		0 to +1000	1.0Ω/ 1 count			0.122Ω/ 2 counts			0.100Ω/ 1 count	
3000Ω		0.641Ω/14 counts		0 to +30000	0.700Ω/ 7 counts		0 to +3000	1.0Ω/1 count			0.732Ω/4 counts			0.900Ω/ 3 counts	

Table 3.11 Effective Resolution and Range for 250 Hz Filter Frequency

Input Type	Raw/Proportional Data Over Full Input Range			Engineering Units x 1 Over Full Range			Engineering Units x 10 Over Full Range			Scaled for PID Over Full Range			Percent of Full Scale 0 to 100%		
	Decimal Range	Resolution °C	Resolution °F	Decimal Range	Resolution °C	Resolution °F	Decimal Range	Resolution °C	Resolution °F	Decimal Range	Resolution °C	Resolution °F	Decimal Range	Resolution °C	Resolution °F
100Ω Pt 385	±32767	0.224°C/ 14 counts	0.404°F/ 14 counts	-2000 to +8500	0.3°C/ 3 counts	0.540°F/ 3 counts	-200 to +850	1.0°C/ 1 count	1.8°F/1 count	0 to 16383	0.256°C/ 4 counts	0.461°F/ 4 counts	0 to 10000	0.315°C/ 3 counts	0.567°F/ 3 counts
200Ω Pt 385		0.224°C/ 14 counts	0.404°F/ 14 counts	-2000 to +8500	0.3°C/ 3 counts	0.540°F/ 3 counts	-200 to +850	1.0°C/ 1 count	1.8°F/1 count		0.256°C/ 4 counts	0.461°F/ 4 counts		0.315°C/ 3 counts	0.567°F/ 3 counts
500Ω Pt 385		0.176°C/ 11 counts	0.317°F/ 11 counts	-2000 to +8500	0.2°C/ 2 counts	0.360°F/ 2 counts	-200 to +850	1.0°C/ 1 count	1.8°F/1 count		0.192°C/ 3 counts	0.346°F/ 3 counts		0.210°C/ 2 counts	0.378°F/ 2 counts
1000Ω Pt 385		0.176°C/ 11 counts	0.317°F/ 11 counts	-2000 to +8500	0.2°C/ 2 counts	0.360°F/ 2 counts	-200 to +850	1.0°C/ 1 count	1.8°F/1 count		0.192°C/ 3 counts	0.346°F/ 3 counts		0.210°C/ 2 counts	0.378°F/ 2 counts
100Ω Pt 3916		0.114°C/ 9 counts	0.205°F/ 9 counts	-2000 to +6300	0.2°C/ 2 counts	0.360°F/ 2 counts	-200 to +630	1.0°C/ 1 count	1.8°F/1 count		0.152°C/ 3 counts	0.274°F/ 3 counts		0.166°C/ 2 counts	0.299°F/ 2 counts
200Ω Pt 3916		0.114°C/ 9 counts	0.205°F/ 9 counts	-2000 to +6300	0.2°C/ 2 counts	0.360°F/ 2 counts	-200 to +630	1.0°C/ 1 count	1.8°F/1 count		0.152°C/ 3 counts	0.274°F/ 3 counts		0.166°C/ 2 counts	0.299°F/ 2 counts
500Ω Pt 3916		0.101°C/ 8 counts	0.182°F/ 8 counts	-2000 to +6300	0.1°C/ 1 count	0.18°F/ 1 count	-200 to +630	1.0°C/ 1 count	1.8°F/1 count		0.101°C/ 2 counts	0.182°F/ 2 counts		0.166°C/ 2 counts	0.299°F/ 2 counts
1000Ω Pt 3916		0.190°C/ 15 counts	0.342°F/ 15 counts	-2000 to +6300	0.2°C/ 2 counts	0.360°F/ 2 counts	-200 to +630	1.0°C/ 1 count	1.8°F/1 count		0.203° C/ 4 counts	0.365°F/ 4 counts		0.249° C/ 3 counts	0.448°F/ 3 counts
10Ω Cu 426		15.381°C/ 2800 counts	27.686°F/ 2800 counts	-1000 to +2600	15.4°C/ 154 counts	27.72°F/ 154 counts	-100 to +260	16.0°C/ 16 counts	28.8°F/ 16 counts		15.381°C/ 700 counts	27.686°F/ 700 counts		15.406°C / 428 counts	27.732°F/ 428 counts
120Ω Ni 618		0.110°C/ 20 counts	0.198°F/ 20 counts	-1000 to +2600	0.2°C/ 2 counts	0.360°F/ 2 counts	-100 to +260	1.0°C/ 1 count	1.8°F/ 1 count		0.110°C/ 5 counts	0.198°F/ 5 counts		0.108°C/ 3 counts	0.194°F/ 3 counts
120Ω Ni 672		0.042°C/ 8 counts	0.075°F/ 8 counts	-800 to +2600	0.1°C/ 1 count	0.18°F/ 1 count	-80 to +260	1.0°C/ 1 count	1.8°F/ 1 count		0.042°C/ 2 counts	0.075°F/ 2 counts		0.068°C/ 2 counts	0.122°F/ 2 counts
604Ω NiFe 518		0.242°C/ 44 counts	0.363°F/ 44 counts	-1000 to +2000	0.240°C/ 2 counts	0.360°F/ 2 counts	-100 to +200	1.2°C/ 1 count	1.8°F/ 1 count		0.242°C/ 11 counts	0.363°F/ 11 counts		0.252°C/ 7 counts	0.378°F/ 7 counts
150Ω		0.078Ω/ 34 counts		0 to +15000	0.080Ω/ 8 counts		0 to +1500	0.10Ω/1 count			0.082Ω/ 9 counts			0.090Ω/ 6 counts	
500Ω		0.046Ω/ 6 counts		0 to +5000	0.1Ω/ 1 count		0 to +500	1.0Ω/1 count			0.061Ω/ 2 count			0.050Ω/ 1 count	
1000Ω		0.092Ω/ 6 counts		0 to +10000	0.1Ω/ 1 count		0 to +1000	1.0Ω/1 count			0.122Ω/ 2 counts			0.100Ω/ 1 count	
3000Ω		0.641Ω/ 14 counts		0 to +30000	0.7Ω/ 7 counts		0 to +3000	1.0Ω/1 count			0.732Ω/ 4 counts			0.900Ω/ 3 counts	

Table 3.12 Effective Resolution and Range for 500 Hz Filter Frequency

Input Type	Raw/Proportional Data Over Full Input Range			Engineering Units x 1 Over Full Range			Engineering Units x 10 Over Full Range			Scaled for PID Over Full Range			Percent of Full Scale 0 to 100%		
	Decimal Range	Resolution		Decimal Range	Resolution		Decimal Range	Resolution		Decimal Range	Resolution		Decimal Range	Resolution	
		°C	°F		°C	°F		°C	°F		°C	°F		°C	°F
100Ω Pt 385	±32767	6.905°C/ 431 counts	12.430°F/ 431 counts	-2000 to +8500	6.900°C/ 69 counts	12.42°F/ 69 counts	-200 to +850	7.0°C/ 7 counts	12.6°F/ 7 counts	0 to 16383	6.921°C/ 108 counts	12.458°F/ 108 counts	0 to 10000	6.929°C/ 66 counts	12.473°F/ 66 counts
200Ω Pt 385		1.730°C/ 108 counts	3.115°F/ 108 counts	-2000 to +8500	1.800°C/ 18 counts	3.24°F/ 18 counts	-200 to +850	2.0°C/ 2 counts	3.6°F/ 2 counts		1.730°C/ 27 counts	3.115°F/ 27 counts		1.785°C/ 17 counts	3.213°F/ 17 counts
500Ω Pt 385		0.705°C/ 44 counts	1.269°F/ 44 counts	-2000 to +8500	0.700°C/ 7 counts	1.26°F/ 7 counts	-200 to +850	1.0°C/ 1 count	1.8°F/ 1 count		0.705°C/ 11 counts	1.269°F/ 11 counts		0.735°C/ 7 counts	1.323°F/ 7 counts
1000Ω Pt 385		1.394°C/ 87 counts	2.509°F/ 87 counts	-2000 to +8500	1.40°C/ 14 counts	2.52°F/ 14 counts	-200 to +850	2.0°C/ 2 counts	3.6°F/ 2 counts		1.410°C/ 22 counts	2.538°F/ 22 counts		1.470°C/ 14 counts	2.646°F/ 14 counts
100Ω Pt 3916		1.824°C/ 114 counts	3.283°F/ 114 counts	-2000 to +6300	1.90°C/ 19 counts	3.42°F/ 19 counts	-200 to +630	2.0°C/ 2 counts	3.6°F/ 2 counts		1.824°C/ 36 counts	3.283°F/ 36 counts		1.826°C/ 22 counts	3.286°F/ 22 counts
200Ω Pt 3916		0.456°C/ 36 counts	0.821°F/ 36 counts	-2000 to +6300	0.50°C/ 5 counts	0.90°F/ 5 counts	-200 to +630	1.0°C/ 1 count	1.8°F/ 1 count		0.456°C/ 9 counts	0.821°F/ 9 counts		0.498°C/ 6 counts	0.896°F/ 6 counts
500Ω Pt 3916		1.469°C/ 116 counts	2.644°F/ 116 counts	-2000 to +6300	1.50°C/ 15 counts	2.70°F/ 15 counts	-200 to +630	2.0°C/ 2 counts	3.6°F/ 2 counts		1.469°C/ 29 counts	2.644°F/ 29 counts		1.494°C/ 18 counts	2.689°F/ 18 counts
1000Ω Pt 3916		1.469°C/ 116 counts	2.644°F/ 116 counts	-2000 to +6300	1.50°C/ 15 counts	2.70°F/ 15 counts	-200 to +630	2.0°C/ 2 counts	3.6°F/ 2 counts		1.469°C/ 29 counts	2.644°F/ 29 counts		1.494°C/ 18 counts	2.689°F/ 18 counts
10Ω Cu 426		123.014°C / 22394 counts	221.425°F / 22394 counts	-1000 to +2600	123.10°C / 1231 counts	221.58°F/ 1231 counts	-100 to +260	124.0°C / 124 counts	223.2°F /124 counts		123.025°C / 5599 counts	221.445°F / 5599 counts		123.036° C / 3418 counts	221.464° F/3418 counts
120Ω Ni 618		0.851°C/ 155 counts	1.533°F/ 155 counts	-1000 to +2600	0.90°C/ 9 counts	1.62°F/ 9 counts	-100 to +260	1.0°C/ 1 count	1.8°F/ 1 count		0.857°C/ 39 counts	1.542°F/ 39 counts		0.864°C/ 24 counts	1.555°F/ 24 counts
120Ω Ni 672		1.328°C/ 256 counts	2.391°F/ 256 counts	-800 to +2600	1.40°C/ 14 counts	2.52°F/ 14 counts	-80 to +260	2.0°C/ 2 counts	3.6°F/ 2 counts		1.328°C/ 64 counts	2.391°F/ 64 counts		1.326°C/ 39 counts	2.387°F/ 39 counts
604Ω NiFe 518		1.895°C/ 345 counts	2.843°F/ 345 counts	-1000 to +2000	1.92°C/ 16 counts	2.88°F/ 16 counts	-100 to +200	2.4°C/ 2 counts	3.6°F/ 2 counts		1.912°C/ 87 counts	2.867°F/ 87 counts		1.908°C/ 53 counts	2.862°F/ 53 counts
150Ω		0.611Ω/ 267 counts		0 to +15000	0.62Ω/ 62 counts		0 to +1500	0.7Ω/ 7 counts			0.613Ω/ 67 counts			0.615Ω/ 41 counts	
500Ω		0.313Ω/ 41 counts		0 to +5000	0.40Ω/ 4 counts		0 to +500	1.0Ω/ 1 count			0.336Ω/ 11 counts			0.350Ω/ 7 counts	
1000Ω		0.626Ω/ 41 counts		0 to +10000	0.70Ω/ 7 counts		0 to +1000	1.0Ω/ 1 count			0.671Ω/ 11 counts			0.700Ω/ 7 counts	
3000Ω		4.898Ω/ 107 counts		0 to +30000	4.90Ω/ 49 counts		0 to +3000	5.0Ω/ 5 counts			4.944Ω/ 27 counts			5.099Ω/ 17 counts	

Table 3.13 Effective Resolution and Range for 1 kHz Filter Frequency

Input Type	Raw/Proportional Data Over Full Input Range			Engineering Units x 1 Over Full Range			Engineering Units x 10 Over Full Range			Scaled for PID Over Full Range			Percent of Full Scale 0 to 100%		
	Decimal Range	Resolution		Decimal Range	Resolution		Decimal Range	Resolution		Decimal Range	Resolution		Decimal Range	Resolution	
		°C	°F		°C	°F		°C	°F		°C	°F		°C	°F
100Ω Pt 385	±32767	6.905°C/ 431 counts	12.430°F/ 431 counts	-2000 to +8500	6.900°C/ 69 counts	12.420°F/ 69 counts	-200 to +850	7.00°C/ 7 counts	12.60°F/ 7 counts	0 to 16383	6.921°C/ 108 counts	12.458°F/ 108 counts	0 to 10000	6.929°C/ 66 counts	12.473°F/ 66 counts
200Ω Pt 385		3.461°C/ 216 counts	6.229°F/ 216 counts	-2000 to +8500	3.500°C/ 35 counts	6.300°F/ 35 counts	-200 to +850	4.00°C/ 4 counts	7.20°F/ 4 counts		3.461°C/ 54 counts	6.229°F/ 54 counts		3.465°C/ 33 counts	6.236°F/ 33 counts
500Ω Pt 385		1.394°C/ 87 counts	2.509°F/ 87 counts	-2000 to +8500	1.400°C/ 14 counts	2.520°F/ 14 counts	-200 to +850	2.00°C/ 2 counts	3.60°F/ 2 counts		1.410°C/ 22 counts	2.538°F/ 22 counts		1.470°C/ 14 counts	2.646°F/ 14 counts
1000Ω Pt 385		2.772°C/ 173 counts	4.989°F/ 173 counts	-2000 to +8500	2.800°C/ 28 counts	5.040°F/ 28 counts	-200 to +850	3.00°C/ 3 counts	5.40°F/ 3 counts		2.820°C/ 44 counts	5.076°F/ 44 counts		2.385°C/ 27 counts	5.102°F/ 27 counts
100Ω Pt 3916		3.647°C/ 288 counts	6.565°F/ 288 counts	-2000 to +6300	3.70°C/ 37 counts	6.660°F/ 37 counts	-200 to +630	4.00°C/ 4 counts	7.20°F/ 4 counts		3.647°C/ 72 counts	6.565°F/ 72 counts		3.652°C/ 44 counts	6.573°F/ 44 counts
200Ω Pt 3916		1.824°C/ 144 counts	3.283°F/ 144 counts	-2000 to +6300	1.900°C/ 19 counts	3.420°F/ 19 counts	-200 to +630	2.00°C/ 2 counts	3.60°F/ 2 counts		1.824°C/ 36 counts	3.283°F/ 36 counts		1.826°C/ 22 counts	3.286°F/ 22 counts
500Ω Pt 3916		2.926°C/ 231 counts	5.266°F/ 231 counts	-2000 to +6300	3.000°C/ 30 counts	5.4°F/ 30 counts	-200 to +630	3.00°C/ 3 counts	5.40°F/ 3 counts		2.938°C/ 58 counts	5.289°F/ 58 counts		2.988°C/ 36 counts	5.378°F/ 36 counts
1000Ω Pt 3916		2.926°C/ 231 counts	5.266°F/ 231 counts	-2000 to +6300	3.000°C/ 30 counts	5.4°F/ 30 counts	-200 to +630	3.00°C/ 3 counts	5.40°F/ 3 counts		2.938°C/ 58 counts	5.289°F/ 58 counts		2.988°C/ 36 counts	5.378°F/ 36 counts
10Ω Cu 426		984.084°C / 179147 counts	1771.351°F /179147 counts	-1000 to +2600	984.100°C / 9841 counts	1771.380°F /9841 counts	-100 to +260	985.00°C / 985 counts	1773.00°F /985 counts		984.089°C / 44787 count	1771.361°F /44787 counts		984.106°C / 27339 counts	1771.390°F / 27339 counts
120Ω Ni 618		1.697°C/ 309 counts	3.055°F/ 309 counts	-1000 to +2600	1.700°C/ 17 counts	3.060°F/ 17 counts	-100 to +260	2.00°C/ 2 counts	3.60°F/ 2 counts		1.714°C/ 78 counts	3.085°F/ 78 counts		1.728°C/ 48 counts	3.110°F/ 48 counts
120Ω Ni 672		1.328°C/ 256 counts	2.391°F/ 256 counts	-800 to +2600	1.400°C/ 14 counts	2.520°F/ 14 counts	-80 to +260	2.00°C/ 2 counts	3.60°F/ 2 counts		1.328°C/ 64 counts	2.391°F/ 64 counts		1.326°C/ 39 counts	2.387°F/ 39 counts
604Ω NiFe 518		7.570°C/ 1378 counts	11.354°F/ 1378 counts	-1000 to +2000	7.680°C/ 64 counts	11.520°F/ 64 counts	-100 to +200	8.40°C/ 7 counts	12.60°F/ 7 counts		7.581°C/ 345 counts	11.371°F/ 345 counts		7.595°C/ 211 counts	11.393°F/ 211 counts
150Ω		2.442Ω / 1067 counts		0 to +15000	2.450Ω / 245 counts		0 to +1500	2.50Ω /25 counts			2.44Ω / 267 counts			2.445Ω / 163 counts	
500Ω		1.228Ω / 161 counts		0 to +5000	1.300Ω / 13 counts		0 to +500	2.00Ω / 2 counts			1.251Ω / 41 counts			1.250Ω / 25 counts	
1000Ω		4.898Ω / 321 counts		0 to +10000	4.900Ω / 49 counts		0 to +1000	5.00Ω / 5 counts			4.944Ω / 81 counts			4.900Ω / 49 counts	
3000Ω		9.796Ω / 214 counts		0 to +30000	9.800Ω / 98 counts		0 to +3000	10.00Ω / 10 counts			9.888Ω / 54 counts			9.899Ω / 33 counts	

The table below identifies the number of significant bits used to represent the input data for each available filter frequency. The number of significant bits is defined as the number of bits that will have little or no jitter due to noise, and is used in defining the effective resolution. Note that the resolutions provided by the filters apply to the raw/proportional data format only.

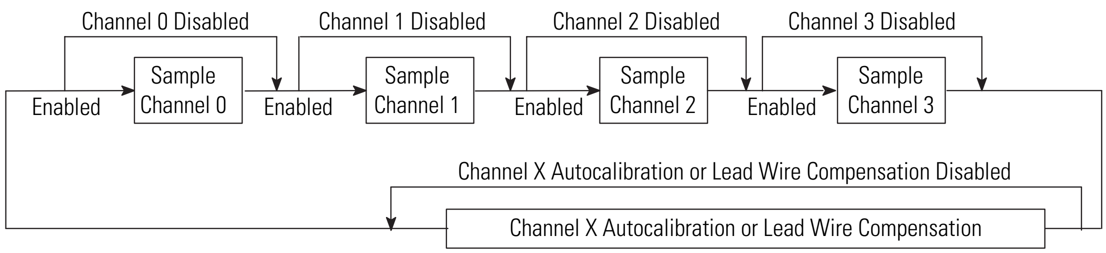
Table 3.14 Input Effective Resolution Versus Input Filter Selection (Across Full Raw/Proportional Range)

Input Type	Number of Significant Bits				
	10 Hz	50/60 Hz	250 Hz	500 Hz	1000 Hz
100Ω Platinum 385 with 0.5 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 7 bits	Sign + 6 bits
100Ω Platinum 385 with 1.0 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 8 bits	Sign + 8 bits	Sign + 5 bits
200Ω Platinum 385 with 0.5 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
200Ω Platinum 385 with 1.0 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 5 bits
500Ω Platinum 385 with 0.5 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
500Ω Platinum 385 with 1.0 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 5 bits
1000Ω Platinum 385 with 0.5 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
1000Ω Platinum 385 with 1.0 mA excitation current	not valid				
100Ω Platinum 3916 with 0.5 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 6 bits	Sign + 5 bits
100Ω Platinum 3916 with 1.0 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
200Ω Platinum 3916	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
500Ω Platinum 3916 with 0.5 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
500Ω Platinum 3916 with 1.0 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
1000Ω Platinum 3916 with 0.5 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
1000Ω Platinum 3916 with 1.0 mA excitation current	not valid				
10Ω Copper 426 with 0.5 mA excitation current	not valid				
10Ω Copper 426 with 1.0 mA excitation current	Sign + 11 bits	Sign + 9 bits	Sign + 7 bits	Sign + 5 bits	Sign + 2 bits
120Ω Nickel 618 with 0.5 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 8 bits	Sign + 7 bits	Sign + 4 bits
120Ω Nickel 618 with 1.0 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
120Ω Nickel 672 with 0.5 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 8 bits	Sign + 7 bits	Sign + 5 bits
120Ω Nickel 672 with 1.0 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
604Ω Nickel-Iron 518 with 0.5 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
604Ω Nickel-Iron 518 with 1.0 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 7 bits	Sign + 6 bits
150Ω with 0.5 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 8 bits	Sign + 6 bits	Sign + 5 bits
150Ω with 1.0 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 5 bits
500Ω	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
1000Ω	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
3000Ω with 0.5 mA excitation current	Sign + 13 bits	Sign + 11 bits	Sign + 9 bits	Sign + 8 bits	Sign + 6 bits
3000Ω with 1.0 mA excitation current	not valid				

Determining Module Update Time

The module update time is defined as the time required for the module to sample and convert the input signals of all enabled input channels and provide the resulting data values to the processor. The module sequentially samples the channels in a continuous loop as shown below.

Module Update Sequence



Module update time is dependent on the number of input channels enabled, input filter selection, and whether or not a calibration or lead wire compensation sequence is in progress.

The fastest module update time occurs when only one channel is enabled with a 1 kHz filter, with autocalibration and cyclic lead compensation disabled. If more than one channel is enabled, the update time is faster if all channels use the fastest filter, as shown in example 1 below. The slowest module update time occurs when all six channels are enabled with the 10Hz filter.

The following table shows the channel update times for all filter frequencies assuming that no calibration or lead wire compensation is in progress.

Table 3.15 Channel Update Time vs. Filter Frequency

Filter Frequency	Maximum Channel Update Time(1)	
	with 1 channel enabled	with 4 channels enabled
10 Hz	303 ms	1212 ms
50 Hz	63 ms	252 ms
60 Hz	53 ms	212 ms
250 Hz	15 ms	60 ms
500 Hz	9 ms	36 ms
1 kHz	6 ms	24 ms

(1) Update times do not include cyclic calibration or lead wire compensation.

Module update time can be calculated by obtaining the sum of all enabled channel update times. Channel update times include channel scan time, channel switching time, and reconfiguration time.

EXAMPLE

1. Module Update Time with all channels enabled and configured with 10 Hz filter = 4 x 303 ms = 1212 ms
2. Module Update Time with all channels enabled and using the 1 kHz filter = 4 x 6 ms = 24 ms

Effects of Autocalibration on Module Update Time

The module's autocalibration feature allows it to correct for accuracy errors caused by component temperature drift over the module operating temperature range (0 to 55°C). Autocalibration occurs automatically on a system mode change from Program-to-Run for all configured channels. In addition, the module allows you to configure it to perform an autocalibration cycle every 5 minutes during normal operation or to disable this feature using the Enable/Disable Cyclic Calibration function (default: Enable). With this feature, you can implement a calibration cycle anytime, using your control program to enable and then disable this bit.

If you enable the autocalibration function, the module update time increases when the autocalibration cycle occurs. To limit its impact on module update time, the autocalibration function is divided over several module scans.

Each enabled channel requires a separate 4-step cycle. If cyclic lead compensation is disabled, each enabled channel requires only a separate 3-step autocalibration cycle. The time added to the module update time depends on the filter selected for that channel as shown in Table 3.16 below.

Table 3.16 Calibration Times by Input Filter Selection

	10 Hz	50 Hz	60 Hz	250 Hz	500 Hz	1 KHz
RTD ADC Self-calibration	603 ms	123 ms	103 ms	27 ms	15 ms	9 ms
Current ADC Self-calibration	603 ms	123 ms	103 ms	27 ms	15 ms	9 ms
Current Source Calibration	303 ms	63 ms	53 ms	15 ms	9 ms	6 ms
Lead Wire ADC Self-calibration (if cyclic lead compensation enabled)	630 ms	150 ms	130 ms	42 ms	30 ms	24 ms

Calculating Module Update Time with Autocalibration Enabled

The following example illustrates how to determine module update time with autocalibration enabled.

EXAMPLE

Two Channels Enabled with Cyclic Calibration

Channel 0 Input: 100Ω Platinum 385, 1.0 mA source with 60 Hz Filter
Channel 1 Input: 100Ω Platinum 385, 0.5 mA source with 60 Hz Filter

From Table 3.15, Channel Update Time vs. Filter Frequency, on page 3-27:

1. Calculate Module Update Time *without* an Autocalibration Cycle

= Ch 0 Update Time + Ch 1 Update Time = 53 ms + 53 ms = 106 ms

2. Calculate Module Update Time *during* an Autocalibration Cycle

Channel 0 Step 1 (Module Scan 1)
= Ch 0 Update Time + Ch 1 Update Time + *RTD ADC Self-calibration Time* = 53 ms + 53 ms + *103* ms = 209 ms

Channel 0 Step 2 (Module Scan 2)
= Ch 0 Update Time + Ch 1 Update Time + *Current ADC Self-calibration Time* = 53 ms + 53 ms + *103* ms = 209 ms

Channel 0, Step 3 (Module Scan 3)
= Ch 0 Update Time + Ch 1 Update Time + *Current Source Calibration Time* = 53 ms + 53 ms + *53* ms = 159 ms

Channel 0, Step 4 (Module Scan 4)
= Ch 0 Update Time + Ch 1 Update Time + *Ch 0 Lead Compensation ADC Calibration Time*
= 53 ms + 53 ms + *130* ms = 236 ms

Channel 1, Step 1 (Module Scan 5)
= Ch 0 Update Time + Ch 1 Update Time + *Ch 1 RTD ADC Self-calibration Time*
= 53 ms + 53 ms + *103* ms = 209 ms

Channel 1, Step 2 (Module Scan 6)
= Ch 0 Update Time + Ch 1 Update Time + *Ch 1 Current ADC Self-calibration Time*
= 53 ms + 53 ms + *103* ms = 209 ms

Channel 1, Step 3 (Module Scan 7)
= Ch 0 Update Time + Ch 1 Update Time + *Ch 1 ADC Self-calibration Time*
= 53 ms + 53 ms + *53* ms = 159 ms

Channel 1, Step 4 (Module Scan 8)
= Ch 0 Update Time + Ch 1 Update Time + *Ch 1 Lead Compensation ADC Calibration Time*
= 53 ms + 53 ms + *130* ms = 236 ms

3. Calculate Total Time to Complete Autocalibration Cycle

= (Channel 0 Step Times) + (Channel 1 Step Times)
= (209 ms + 209 ms + 159 ms + 236 ms) + (209 ms + 209 ms + 159 ms + 236 ms)
= 786 ms + 786 ms = 1626 ms = 1.626 seconds

After the above cycles are complete, the module returns to scans without autocalibration for approximately 5 minutes. At that time, the autocalibration cycle repeats. If both cyclic autocalibration and lead wire compensation (see page 3-30) are enabled, the two functions run concurrent to one another.

Effects of Cyclic Lead Wire Compensation on Module Update Time

The 1762-IR4 module provides the option to enable lead wire compensation for each channel. This feature improves measurement accuracy for 3- and 4-wire RTDs by compensating for the resistance of the RTD lead wire. Lead wire compensation occurs automatically on a mode change from Program-to-Run for all configured channels regardless of the type of RTD being used. In addition, you can either configure the module to perform a lead wire compensation cycle every 5 minutes during normal operation or disable this feature using the Enable/Disable Cyclic Lead Wire function (default: Enable). You can also implement a lead wire compensation cycle anytime, using your control program to enable and then disable this function.

If you enable the cyclic lead wire compensation function, the module update time will increase when the lead wire compensation cycle occurs. To limit its impact on module update time, the lead wire compensation function is divided over 2 module scans. The amount of time added for lead wire compensation per module scan depends on the filter frequency (channel update time) selected for that channel.

The amount of time added to each module scan during a Lead Compensation Cycle depends on the filter frequency selected for that channel and can be found in Table 3.15 on page 3-27.

Calculating Module Update Time with Cyclic Lead Wire Compensation Enabled

The following example illustrates how to determine module update time with cyclic lead wire compensation enabled.

EXAMPLE **Two Channels Configured with Cyclic Lead Wire Compensation Enabled**

Channel 0 Input: 100Ω Platinum 385 with 60 Hz Filter (use 60 Hz filter for lead wire)
Channel 1 Input: 100Ω Platinum 385 with 250 Hz Filter (use 250 Hz filter for lead wire)

From Table 3.15, Channel Update Time vs. Filter Frequency, on page 3-27:

1. Calculate Module Update Time *without* a Lead Wire Compensation Cycle

= Ch 0 Update Time + Ch 1 Update Time = 53 ms + 15 ms = 68 ms

2. Calculate Module Update Time *during* a Lead Wire Compensation Cycle

Channel 0 Scan 1 (Module Scan 1)
Ch 0 Update Time + *Ch 0 Lead Wire Compensation Time* + Ch 1 Update Time
= 53 ms + *53* ms + 15 ms = 121 ms

The above module update time impact lasts for one more module scan, before the lead-wire compensation cycle is complete for Channel 0:

Channel 0 Lead Wire Compensation Cycle Time
= (2 x 121 ms) = 242 ms

After that, a 2-scan lead wire cycle begins for Channel 1:

Channel 1 Scan 1 (Module Scan 3)
= Ch 0 Update Time + Ch 1 Update Time + *Ch 1 Lead Wire Compensation Time*
= 53 ms + 15 ms + *15* ms = 83 ms

The above module update time impact lasts for one more module scan, before the lead-wire compensation cycle is complete for Channel 1:

Channel 1 Lead Wire Compensation Cycle Time
= (2 x 83 ms) = 166 ms

3. Calculate Total Time to Complete Lead Wire Compensation Cycle

= (Ch 0 Lead Wire Compensation Cycle Time) + (Ch 1 Lead Wire Compensation Cycle Time)
= (242 ms) + (166 ms)
= 408 ms = 0.408 seconds

After the above cycles are complete, the module returns to scans without lead wire compensation for approximately 5 minutes. At that time, the lead wire compensation cycle repeats.

If both cyclic autocalibration (see page 3-28) and lead wire compensation are enabled, the two functions run concurrent to one another.

Impact of Autocalibration and Lead Wire Compensation on Module Startup

Regardless of the selection of the Enable/Disable Cyclic Calibration and Enable/Disable Cyclic Lead Calibration functions, a cycle of both of these functions occurs automatically on a mode change from Program-to-Run and on subsequent module startups/initialization for all configured channels. During module startup, input data is not updated by the module until the calibration and compensation cycles are complete. During this time the General Status bits (S0 to S3) are set to 1, indicating a Data Not Valid condition. The time it takes the module to startup is dependent on channel filter frequency selections and other items defined in the previous sections. The following examples show how to calculate the module startup time.

EXAMPLE

Four Channels Enabled with 10 Hz Filters (worst-case startup time)

All 4 Channels: 100Ω Platinum 385 RTD, 1.0 mA current source with 10 Hz filter

Module Startup Time

= (4-step Calibration Time x 4 channels) + (Lead Wire Compensation Time x 4 Channels) + (4-Channel Data Acquisition Time)
= (2139 ms x 4) + (408 ms x 4) + (303 ms x 4)
= 8556 ms + 1632 ms + 1212 ms = 114700 ms = 11.4 seconds

Effects of Autocalibration on Accuracy

The module performs autocalibration to correct for drift errors over temperature. Autocalibration occurs immediately following configuration of a previously unselected channel, during power cycle of enable channels and every 5 minutes if so configured. The table below shows module accuracy with and without calibration.

Table 3.17 Module Accuracy

Input Type(1)	With Autocalibration		Without Autocalibration
	Maximum Error at 25° C (77°F)	Maximum Error at 60° C (140°F)	Temperature Drift (0° C to 60° C) (32°F to 140°F)
100Ω Platinum 385	±0.5° C (±0.9°F)	±0.9° C (±1.62°F)	±0.026° C/° C (±0.026°F/°F)
200Ω Platinum 385	±0.5° C (±0.9°F)	±0.9° C (±1.62°F)	±0.026° C/° C (±0.026°F/°F)
500Ω Platinum 385	±0.5° C (±0.9°F)	±0.9° C (±1.62°F)	±0.026° C/° C (±0.026°F/°F)
1000Ω Platinum 385	±0.5° C (±0.9°F)	±0.9° C (±1.62°F)	±0.026° C/° C (±0.026°F/°F)
100Ω Platinum 3916	±0.4° C (±0.72°F)	±0.8° C (±1.44°F)	±0.023° C/° C (±0.023°F/°F)
200Ω Platinum 3916	±0.4° C (±0.72°F)	±0.8° C (±1.44°F)	±0.023° C/° C (±0.023°F/°F)
500Ω Platinum 3916	±0.4° C (±0.72°F)	±0.8° C (±1.44°F)	±0.023° C/° C (±0.023°F/°F)
1000Ω Platinum 3916	±0.4° C (±0.72°F)	±0.8° C (±1.44°F)	±0.023° C/° C (±0.023°F/°F)
10Ω Copper 426	±0.6° C (±1.08°F)	±1.1° C (±1.98°F)	±0.032° C/° C (±0.032°F/°F)
120Ω Nickel 618	±0.2° C (±0.36°F)	±0.4° C (±0.72°F)	±0.012° C/° C (±0.012°F/°F)
120Ω Nickel 672	±0.2° C (±0.36°F)	±0.4° C (±0.72°F)	±0.012° C/° C (±0.012°F/°F)
604Ω Nickel-Iron 518	±0.3° C (±0.54°F)	±0.5° C (±0.9°F)	±0.015° C/° C (±0.015°F/°F)
150Ω	±0.15Ω	±0.25Ω	±0.007Ω/° C (±0.012Ω/°F)
500Ω	±0.5Ω	±0.8Ω	±0.023Ω/° C (±0.041Ω/°F)
1000Ω	±1.0Ω	±1.5Ω	±0.043Ω/° C (±0.077Ω/°F)
3000Ω	±1.5Ω	±2.5Ω	±0.072Ω/° C (±0.130Ω/°F)

(1) The accuracy values apply to both current sources.

Diagnostics and Troubleshooting

This chapter describes module troubleshooting, containing information on:

- safety considerations when troubleshooting
- module vs. channel operation
- the module's diagnostic features
- critical vs. non-critical errors
- module condition data
- contacting Rockwell Automation for assistance

Safety Considerations

Safety considerations are an important element of proper troubleshooting procedures. Actively thinking about the safety of yourself and others, as well as the condition of your equipment, is of primary importance.

The following sections describe several safety concerns you should be aware of when troubleshooting your control system.

ATTENTION

Never reach into a machine to actuate a switch because unexpected motion can occur and cause injury.

Remove all electrical power at the main power disconnect switches before checking electrical connections or inputs/outputs causing machine motion.

Indicator Lights

When the green LED on the module is illuminated, it indicates that power is applied to the module and that it has passed its internal tests.

Activating Devices When Troubleshooting

When troubleshooting, never reach into the machine to actuate a device. Unexpected machine motion could occur.

Stand Clear of the Equipment

When troubleshooting any system problem, have all personnel remain clear of the equipment. The problem could be intermittent, and sudden unexpected machine motion could occur. Have someone ready to operate an emergency stop switch in case it becomes necessary to shut off power.

Program Alteration

There are several possible causes of alteration to the user program, including extreme environmental conditions, Electromagnetic Interference (EMI), improper grounding, improper wiring connections, and unauthorized tampering. If you suspect a program has been altered, check it against a previously saved master program.

Safety Circuits

Circuits installed on the machine for safety reasons, like over-travel limit switches, stop push buttons, and interlocks, should always be hard-wired to the master control relay. These devices must be wired in series so that when any one device opens, the master control relay is de-energized, thereby removing power to the machine. Never alter these circuits to defeat their function. Serious injury or machine damage could result.

Module Operation vs. Channel Operation

The module performs diagnostic operations at both the module level and the channel level. Module-level operations include functions such as power-up, configuration, and communication with the MicroLogix 1200 controller.

Channel-level operations describe channel-related functions, such as data conversion and over- or under-range detection.

Internal diagnostics are performed at both levels of operation. When detected, module error conditions are immediately indicated by the module status LED. Both module hardware and channel configuration error conditions are reported to the controller. Channel over-range or under-range conditions are reported in the module's input data table. Module hardware errors are reported in the controller's I/O status file. Refer to your controller manual for details.

Power-up Diagnostics

At module power-up, a series of internal diagnostic tests are performed. These diagnostic tests must be successfully completed or the module status LED remains off and a module error results and is reported to the controller.

If module status LED is:	Indicated condition:	Corrective action:
On	Proper Operation	No action required.
Off	Module Fault	Cycle power. If condition persists, replace the module. Call your local distributor or Rockwell Automation for assistance.

Channel Diagnostics

When an input channel is enabled, the module performs a diagnostic check to see that the channel has been properly configured. In addition, the channel is tested on every scan for configuration errors, over-range and under-range, and broken input conditions.

Invalid Channel Configuration Detection

Whenever a channel configuration word is improperly defined, the module reports an error. See pages 4-4 to 4-7 for a description of module errors.

Out-of-Range Detection

When the input signal data received at the channel word is out of the defined operating range, an over-range or under-range error is indicated in input data word 5.

IMPORTANT	There is no under-range error for direct resistance inputs because 0 is a valid number.

Possible causes for an out-of-range condition include:

- The temperature is too hot or too cold for the RTD being used.
- The wrong RTD is being used for the input type selected, or for the configuration that you have programmed.
- The input device is faulty.
- The signal input from the input device is beyond the scaling range.

Open-Wire or Short-Circuit Detection

The module performs an open-circuit or short-circuit input test on all enabled channels on each scan. Whenever an open-circuit or short-circuit condition occurs, the broken input bit for that channel is set in input data word 4.

Possible causes of a broken input condition include:

- the input device is broken
- a wire is loose or cut
- the input device is not installed on the configured channel
- an RTD is internally shorted
- an RTD is not installed correctly

TIP See Open-Circuit Flag Bits (OC0 to OC3) on page 3-4.

Non-critical vs. Critical Module Errors

Non-critical module errors are typically recoverable. Channel errors (over-range or under-range errors) are non-critical. Non-critical error conditions are indicated in the module input data table. Non-critical configuration errors are indicated by the extended error code. See Table 4.3 Extended Error Codes on page 4-7.

Critical module errors are conditions that may prevent normal or recoverable operation of the system. When these types of errors occur, the system typically leaves the run mode of operation until the error can be dealt with. Critical module errors are indicated in Table 4.3 Extended Error Codes on page 4-7.

Module Error Definition Table

Module errors are expressed in two fields as four-digit Hex format with the most significant digit as irrelevant ("don't care"). The two fields are "Module Error" and "Extended Error Information". The structure of the module error data is shown below.

Table 4.1 Module Error Table

"Don't Care" Bits				Module Error			Extended Error Information								
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hex Digit 4				**Hex Digit 3**				**Hex Digit 2**				**Hex Digit 1**			

Module Error Field

The purpose of the module error field is to classify module errors into three distinct groups, as described in the table below. The type of error determines what kind of information exists in the extended error information field. These types of module errors are typically reported in the controller's I/O status file. Refer to your controller manual for details.

Table 4.2 Module Error Types

Error Type	Module Error Field Value Bits 11 through 09 (Bin)	Description
No Errors	000	No error is present. The extended error field holds no additional information.
Hardware Errors	001	General and specific hardware error codes are specified in the extended error information field.
Configuration Errors	010	Module-specific error codes are indicated in the extended error field. These error codes correspond to options that you can change directly. For example, the input range or input filter selection.

Extended Error Information Field

Check the extended error information field when a non-zero value is present in the module error field. Depending upon the value in the module error field, the extended error information field can contain error codes that are module-specific or common to all 1762 analog modules.

TIP If no errors are present in the module error field, the extended error information field will be set to zero.

Hardware Errors

General or module-specific hardware errors are indicated by module error code 1. See Table 4.3 Extended Error Codes on page 4-7.

Configuration Errors

If you set the fields in the configuration file to invalid or unsupported values, the module ignores the invalid configuration, generates a non-critical error, and keeps operating with the previous configuration.

Table 4.3 Extended Error Codes on page 4-7 lists the possible module-specific configuration error codes defined for the module.

Error Codes

The table below explains the extended error code.

Table 4.3 Extended Error Codes

Error Type	Hex Equivalent[1]	Module Error Code	Extended Error Information Code	Error Description
		Binary	Binary	
No Error	X000	000	0 0000 0000	No Error
General Common Hardware Error	X200	001	0 0000 0000	General hardware error; no additional information
	X201	001	0 0000 0001	Power-up reset state
Module-Specific Hardware Error	X300	001	1 0000 0000	General module hardware error
	X301	001	1 0000 0001	Microprocessor hardware error
	X302	001	1 0000 0010	A/D converter error
	X303	001	1 0000 0011	Calibration error
Module-Specific Configuration Error	X400	010	0 0000 0000	General configuration error; no additional information
	X401	010	0 0000 0001	Invalid input filter selected (channel 0)
	X402	010	0 0000 0010	Invalid input filter selected (channel 1)
	X403	010	0 0000 0011	Invalid input filter selected (channel 2)
	X404	010	0 0000 0100	Invalid input filter selected (channel 3)
	X405	010	0 0000 0101	Invalid input format selected (channel 0)
	X406	010	0 0000 0110	Invalid input format selected (channel 1)
	X407	010	0 0000 0111	Invalid input format selected (channel 2)
	X408	010	0 0000 1000	Invalid input format selected (channel 3)
	X409	010	0 0000 1001	Invalid excitation current for input range selected (channel 0)
	X40A	010	0 0000 1010	Invalid excitation current for input range selected (channel 1)
	X40B	010	0 0000 1011	Invalid excitation current for input range selected (channel 2)
	X40C	010	0 0000 1100	Invalid excitation current for input range selected (channel 3)
	X40D	010	0 0000 1101	Reserved bits set

(1) X represents the "Don't Care" digit.

Module Inhibit Function

Whenever the 1762-IR4 module is inhibited, the module continues to provide information about changes at its inputs to the MicroLogix 1200 controller.

Contacting Rockwell Automation

If you need to contact Rockwell Automation for assistance, please have the following information available when you call:

- a clear statement of the problem, including a description of what the system is actually doing. Note the LED state; also note input and output image words for the module.
- a list of remedies you have already tried
- processor type and firmware number (See the label on the processor.)
- hardware types in the system, including all I/O modules
- fault code if the processor is faulted

Specifications

General Specifications

Specification	Value
Dimensions	90 mm (height) x 87 mm (depth) x 40 mm (width) height including mounting tabs is 110 mm 3.54 in. (height) x 3.43 in (depth) x 1.58 in (width) height including mounting tabs is 4.33 in.
Approximate Shipping Weight (with carton)	260g (0.57 lbs.)
Storage Temperature	-40°C to +85°C (-40°F to +185°F)
Operating Temperature	0°C to +55°C (32°F to +131°F)
Operating Humidity	5% to 95% non-condensing
Operating Altitude	2000 meters (6561 feet)
Vibration	Operating: 10 to 500 Hz, 5G, 0.030 in. peak-to-peak
Shock	Operating: 30G
Agency Certification	C-UL certified (under CSA C22.2 No. 142) UL 508 listed CE compliant for all applicable directives C-Tick marked for all applicable acts
Hazardous Environment Class	Class I, Division 2, Hazardous Location, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 No. 213)
Radiated and Conducted Emissions	EN50081-2 Class A
Electrical /EMC:	*The module has passed testing at the following levels:*
• ESD Immunity (EN61000-4-2)	• 4 kV contact, 8 kV air, 4 kV indirect
• Radiated Immunity (EN61000-4-3)	• 10 V/m , 80 to 1000 MHz, 80% amplitude modulation, +900 MHz keyed carrier
• Fast Transient Burst (IEC1000-4-4)	• 2 kV, 5kHz
• Surge Immunity (EN61000-4-5)	• 1 kV galvanic gun
• Conducted Immunity (EN61000-4-6)	• 10 V, 0.15 to 80MHz(1)

(1) Conducted Immunity frequency range may be 150 kHz to 30 MHz if the Radiated Immunity frequency range is 30 MHz to 1000 MHz.

Input Specifications

Specification	1762-IR4	
Input Types	• 100Ω Platinum 385 • 200Ω Platinum 385 • 500Ω Platinum 385 • 1000Ω Platinum 385 • 100Ω Platinum 3916 • 200Ω Platinum 3916 • 500Ω Platinum 3916 • 1000Ω Platinum 3916 • 10Ω Copper 426 • 120Ω Nickel 672 • 120Ω Nickel 618 • 604Ω Nickel-Iron 518 • 0 to 150Ω • 0 to 500Ω • 0 to 1000Ω • 0 to 3000Ω	
Bus Current Draw (max.)	40 mA at 5V dc 50 mA at 24V dc	
Heat Dissipation	1.5 Total Watts (The Watts per point, plus the minimum Watts, with all points enabled.)	
Converter Type	Delta-Sigma	
Resolution	Input filter and configuration dependent.	
Common Mode Rejection	110 dB minimum at 50 Hz with the 10 or 50 Hz filter selected 110 dB minimum at 60 Hz with the 10 or 60 Hz filter selected	
Normal Mode Rejection Ratio	70 dB minimum at 50 Hz with the 10 or 50 Hz filter selected 70 dB minimum at 60 Hz with the 10 or 60 Hz filter selected	
Non-linearity (in percent full-scale)	±0.05%	
Typical Accuracy [Autocalibration Enabled] at 25° C (77°F) Ambient with Module Operating Temperature at 25° C (77°F) (1)	±0.5°C (°F) for Pt 385 ±0.4°C (°F) for Pt 3916 ±0.2°C (°F) for Ni ±0.3°C (°F) for NiFe ±0.6°C (°F) for Cu	±0.15Ω for 150Ω range ±0.5Ω for 500Ω range ±1.0Ω for 1000Ω range ±1.5Ω for 3000Ω range
Typical Accuracy [Autocalibration Enabled] at 0 to 55° C (+32 to +131°F)(1)	±0.9°C (°F) for Pt 385 ±0.8°C (°F) for Pt 3916 ±0.4°C (°F) for Ni ±0.5°C (°F) for NiFe ±1.1°C (°F) for Cu	±0.25Ω for 150Ω range ±0.8Ω for 500Ω range ±1.5Ω for 1000Ω range ±2.5Ω for 3000Ω range

(1) Accuracy is dependent upon the Analog/Digital converter filter rate selection, excitation current selection, data format, and input noise.

Specification	1762-IR4
Accuracy Drift at 0 to 55° C (+32 to +131°F)	±0.026°C/°C (0.026°F/°F) for Pt 385 ±0.023°C/°C (0.023°F/°F) for Pt 3916 ±0.012°C/°C (0.012°F/°F) for Ni ±0.015°C/°C (0.015°F/°F) for NiFe ±0.032°C/°C (0.032°F/°F) for Cu ±0.007Ω/°C (0.012Ω/°F) for 150Ω range ±0.023Ω/°C (0.041Ω/°F) for 500Ω range ±0.043Ω/°C (0.077Ω/°F) for 1000Ω range ±0.072Ω/°C (0.130Ω/°F) for 3000Ω range
Repeatability(1)	±0.1°C (±0.18°F) for Ni and NiFe ±0.2°C (±0.36°F) to ±0.2°C (±0.36°F) for other RTD inputs ±0.04Ω for 150Ω resistances ±0.2Ω for other resistances
Excitation Current Source	0.5 mA and 1.0 mA selectable per channel
Open-Circuit Detection Time(2)	6 to 1212 ms
Channel Update Time	Input filter and configuration dependent.
Input Channel Configuration	Via configuration software screen or the user program (by writing a unique bit pattern into the module’s configuration file). Refer to your controller’s user manual to determine if user program configuration is supported.
Calibration	The module performs autocalibration on channel enable and on a configuration change between channels. You can also program the module to calibrate every five minutes.
Module OK LED	On: module has power, has passed internal diagnostics, and is communicating over the bus. Off: Any of the above is not true.
Channel Diagnostics	Over- or under-range or broken input by bit reporting
Maximum Overload at Input Terminals	±35V dc continuous
Cable Impedance Max.	25Ω (Operating with >25Ω will reduce accuracy.)
Input Impedance	>10 MΩ
Power Supply Distance Rating	6 (The module may not be more than 6 modules away from the system power supply.)
Channel to Bus Isolation	500V ac or 707V dc for 1 minute (type test) 30V ac/30V dc working voltage (IEC Class 2 reinforced insulation)
Channel to Channel Isolation	±10V dc
Vendor I.D. Code	1
Product Type Code	10
Product Code	65

(1) Repeatability is the ability of the module to register the same reading in successive measurements for the same input signal.

(2) Open-circuit detection time is equal to channel update time.

Cable Specifications

Description	Belden #9501	Belden #9533	Belden #83503
When used?	For 2-wire RTDs and potentiometers.	For 3-wire RTDs and potentiometers. Short runs less than 100 feet and normal humidity levels.	For 3-wire RTDs and potentiometers. Long runs greater than 100 feet or high humidity levels.
Conductors	2, #24 AWG tinned copper (7 x 32)	3, #24 AWG tinned copper (7 x 32)	3, #24 AWG tinned copper (7 x 32)
Shield	Beldfoil aluminum polyester shield with copper drain wire.	Beldfoil aluminum polyester shield with copper drain wire	Beldfoil aluminum polyester shield with tinned braid shield.
Insulation	PVC	S-R PVC	Teflon
Jacket	Chrome PVC	Chrome PVC	Red Teflon
Agency Approvals	NEC Type CM	NEC Type CM	NEC Art-800, Type CMP
Temperature Rating	80°C	80°C	200°C

RTD Standards

RTD Type	α(3)	IEC-751 1983, Amend. 2 1995	DIN 43760 1987	SAMA(4) Standard RC21-4-1966	Japanese Industrial Standard JIS C1604-1989	Japanese Industrial Standard JIS C1604-1997	Minco(5)
100 Ω Pt	0.00385	●	●			●	
200 Ω Pt	0.00385	●	●			●	
500 Ω Pt	0.00385	●	●			●	
1000 Ω Pt	0.00385	●	●			●	
100 Ω Pt	0.03916				●		
200 Ω Pt	0.03916				●		
500 Ω Pt	0.03916				●		
1000 Ω Pt	0.03916				●		
10 Ω Cu(1)	0.00426			●			
120 Ω Ni(2)	0.00618		●				
120 Ω Ni	0.00672						●
604 Ω NiFe	0.00518						●

(1) Actual value at 0°C (32°F) is 9.042Ω per SAMA standard RC21-4-1966.
(2) Actual value at 0°C (32°F) is100 Ω per SAMA standard RC21-4-1966.
(3) α is the temperature coefficient of resistance which is defined as the resistance change per ohm per °C.
(4) Scientific Apparatus Makers Association
(5) Minco Type "NA" (Nickel) and Minco Type "FA" (Nickel-Iron)

Two's Complement Binary Numbers

The processor memory stores 16-bit binary numbers. Two's complement binary is used when performing mathematical calculations internal to the processor. Analog input values from the analog modules are returned to the processor in 16-bit two's complement binary format. For positive numbers, the binary notation and two's complement binary notation are identical.

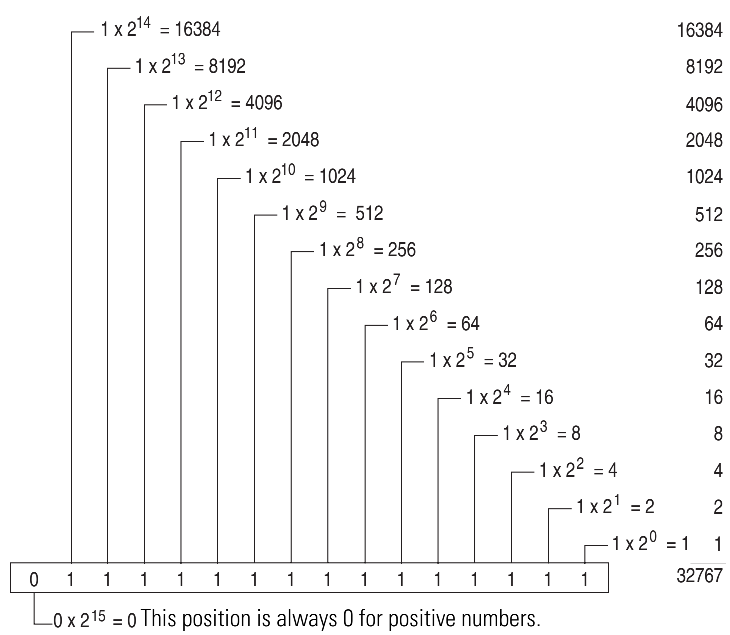
As indicated in the figure on the next page, each position in the number has a decimal value, beginning at the right with 2^0 and ending at the left with 2^{15}. Each position can be 0 or 1 in the processor memory. A 0 indicates a value of 0; a 1 indicates the decimal value of the position. The equivalent decimal value of the binary number is the sum of the position values.

Positive Decimal Values

The far left position is always 0 for positive values. As indicated in the figure below, this limits the maximum positive decimal value to 32767 (all positions are 1 except the far left position). For example:

0000 1001 0000 1110 = $2^{11}+2^8+2^3+2^2+2^1$ = 2048+256+8+4+2 = 2318

0010 0011 0010 1000 = $2^{13}+2^9+2^8+2^5+2^3$ = 8192+512+256+32+8 = 9000

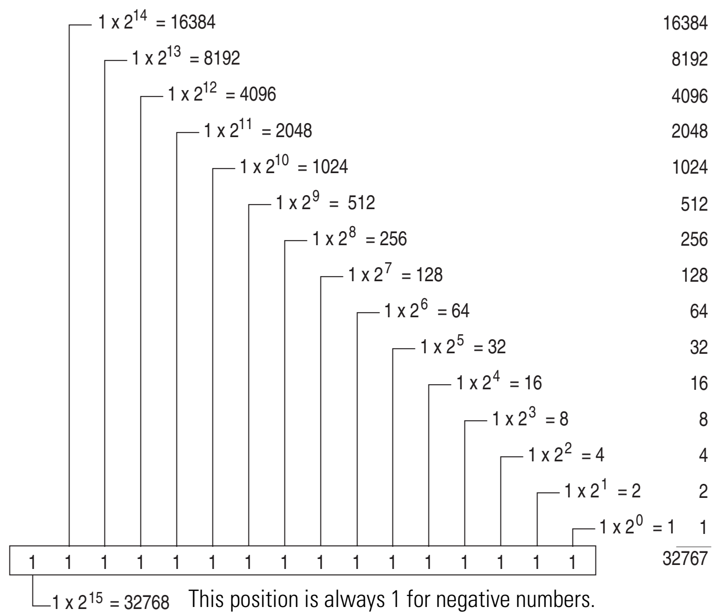


Negative Decimal Values

In two's complement notation, the far left position is always 1 for negative values. The equivalent decimal value of the binary number is obtained by subtracting the value of the far left position, 32768, from the sum of the values of the other positions. In the figure below (all positions are 1), the value is 32767 - 32768 = -1. For example:

$$1111\ 1000\ 0010\ 0011 = (2^{14}+2^{13}+2^{12}+2^{11}+2^{5}+2^{1}+2^{0}) - 2^{15} =$$

$$(16384+8192+4096+2048+32+2+1) - 32768 = 30755 - 32768 = -2013$$

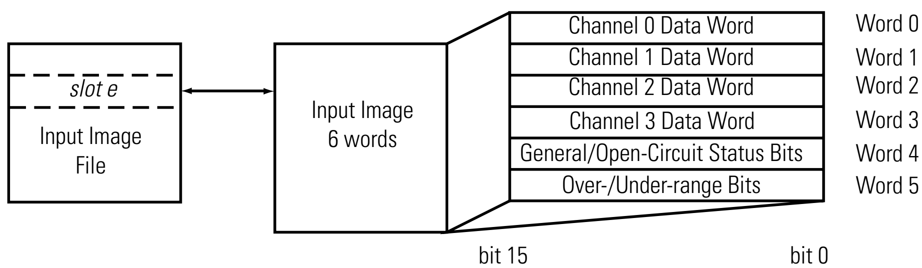


Configuring the 1762-IR4 Module Using RSLogix 500

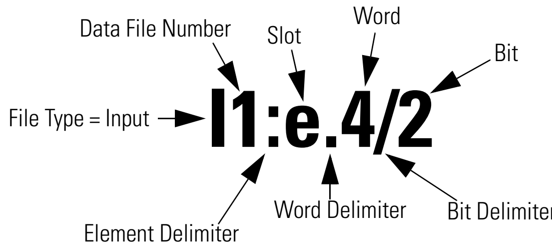
This appendix examines the 1762-IR4 module's addressing scheme and describes module configuration using RSLogix 500.

Module Addressing

The following memory map shows the input image table for the module. Detailed information on the image table is located in Chapter 3.



For example, to obtain the general status of Channel 2 of the module located in slot e, use address I:e.4/2.



1762-IR4 Configuration File

The configuration file contains information you use to define the way a specific channel functions. The configuration file is explained in more detail in Configuring Channels on page 3-5.

The configuration file is modified using the programming software configuration screen. For an example of module configuration using RSLogix 500, see Configuration Using RSLogix 500 Version 5.50 or Higher on page B-2.

The default configuration is as follows:

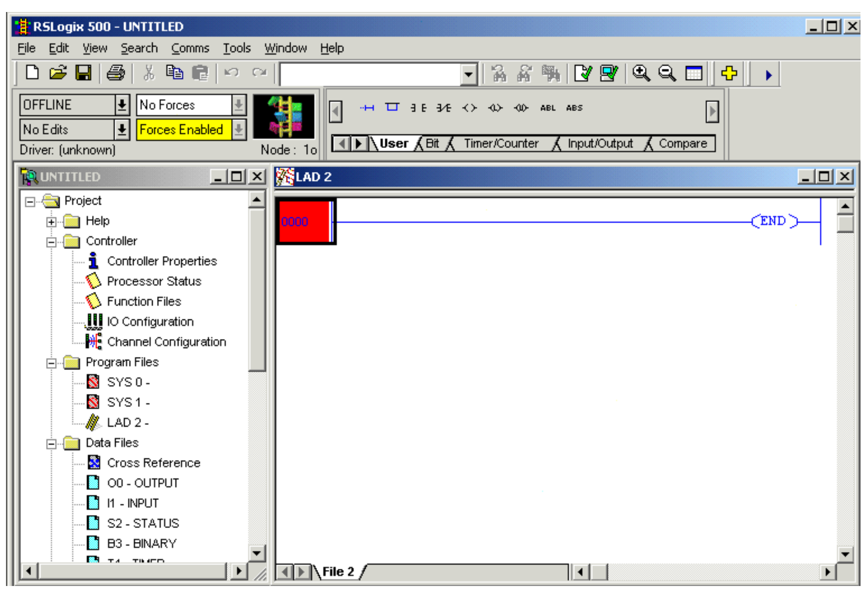
Table B.1 Default Configuration

Parameter	Default Setting
Channel Enable/Disable	Disable
Input Type	100Ω Platinum 385
Data Format	Raw/Proportional
Temperature Units	°C (not applicable with Raw/Proportional)
Broken Input	Upscale
Disable Cyclic Lead Compensation	Enable
Excitation Current	1.0 mA
Input FIlter Frequency	60 Hz

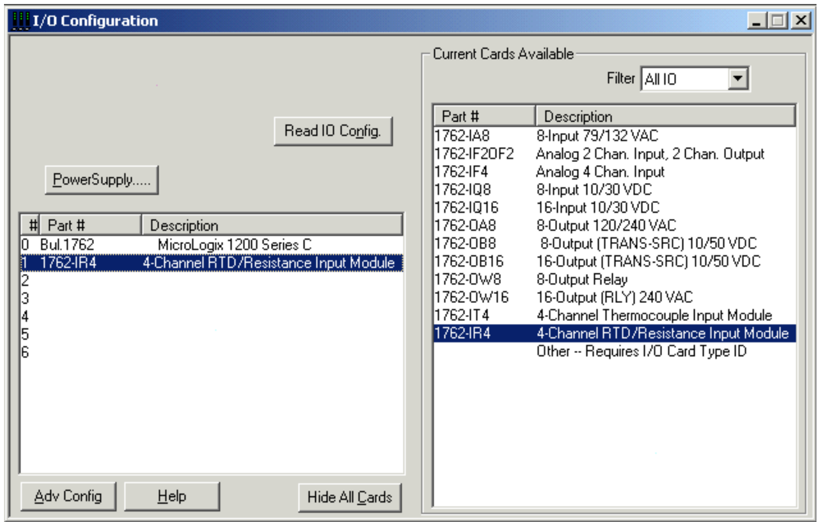
Configuration Using RSLogix 500 Version 5.50 or Higher

This example takes you through configuring your 1762-IR4 RTD/resistance input module with RSLogix 500 programming software. It assumes that your module is installed as expansion I/O in a MicroLogix 1200 system, that RSLinx™ is properly configured, and that a communications link has been established between the MicroLogix processor and RSLogix 500.

Start RSLogix and create a MicroLogix 1200 application. The following screen appears:

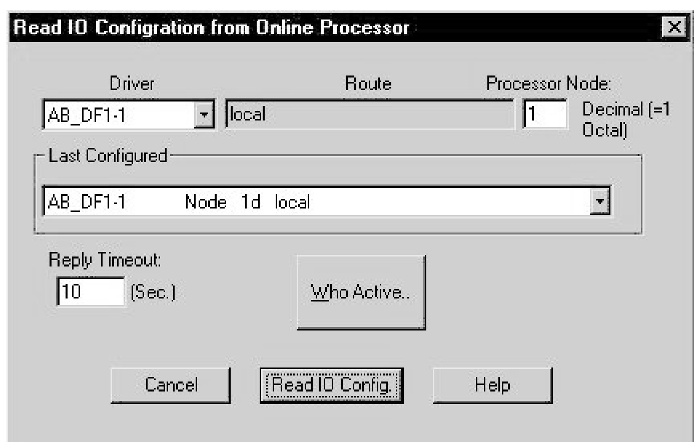


While offline, double-click on the IO Configuration icon under the controller folder and the following IO Configuration screen appears.



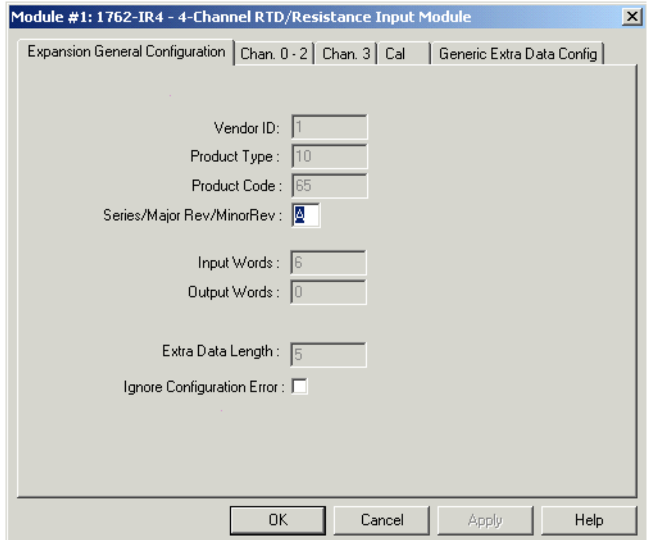
This screen allows you to manually enter expansion modules into expansion slots, or to automatically read the configuration of the controller. To read the existing controller configuration, click on the Read IO Config button.

A communications dialog appears, identifying the current communications configuration so that you can verify the target controller. If the communication settings are correct, click on Read IO Config.

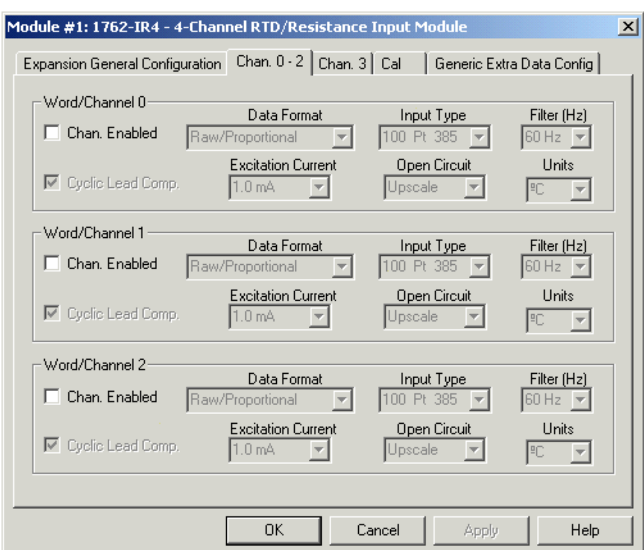


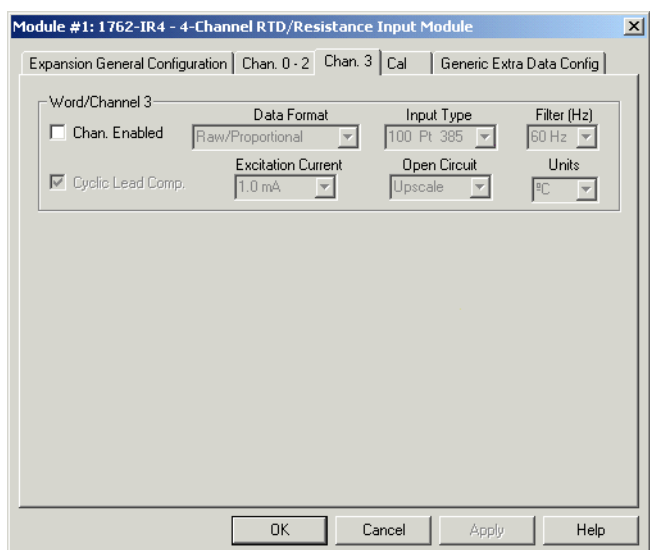
The actual I/O configuration will be displayed.

The 1762-IR4 module is installed in slot 1. To configure the module, double-click on the module/slot. The general configuration screen appears.

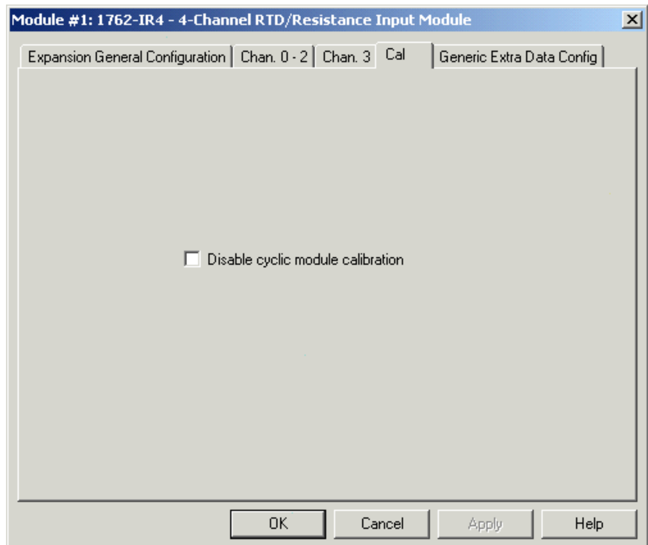


Configuration options for channels 0 to 2 are located on a separate tab from channel 3, as shown below. To enable a channel, click its Enable box so that a check mark appears in it. For optimum module performance, disable any channel that is not hard wired to a real input. Then, choose your Data Format, Input Type, Filter Frequency, Open Circuit response, and Units for each channel. You can also choose to disable cyclic lead compensation for each channel. For more information on cyclic lead compensation, see Selecting Cyclic Lead Compensation (Bit 4) on page 3-16.

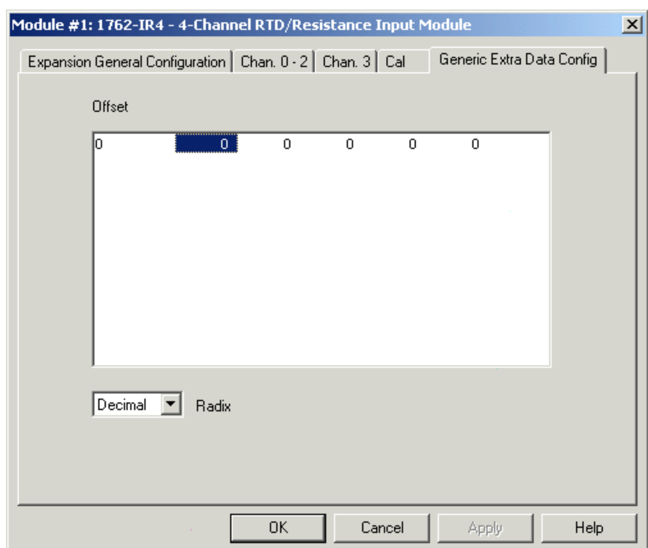




Use the Calibration tab (Cal) to disable cyclic calibration. For more information on the autocalibration feature, see Selecting Enable/Disable Cyclic Autocalibration (Word 4, Bit 0) on page 3-20.



Generic Extra Data Configuration

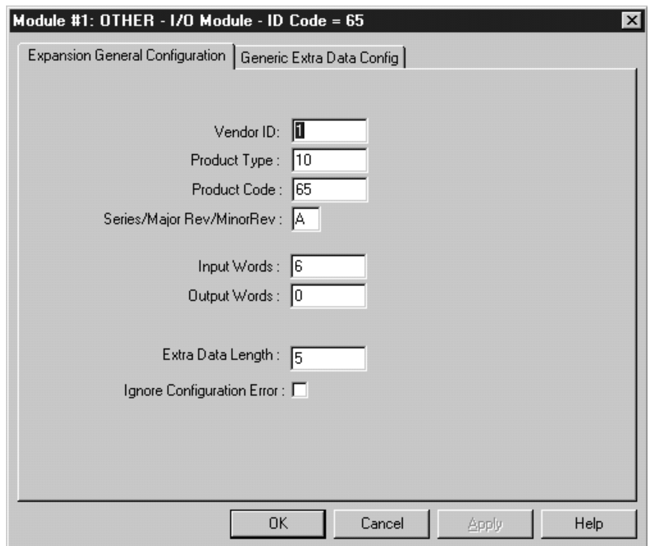


This tab re-displays the configuration information entered on the Analog Input Configuration screen in a raw data format. You have the option of entering the configuration using this tab instead of the module Configuration tab. You do not have to enter data in both places.

Configuration Using RSLogix 500 Version 5.2 or Lower

If you do not have version 5.5 or higher of RSLogix 500, you can still configure your module, using the Generic Extra Data Configuration dialog.

To configure the 1762-IR4, select "Other -- Requires I/O Card Type ID" from the I/O Configuration dialog. The following screen appears. Enter the I/O module information as shown.

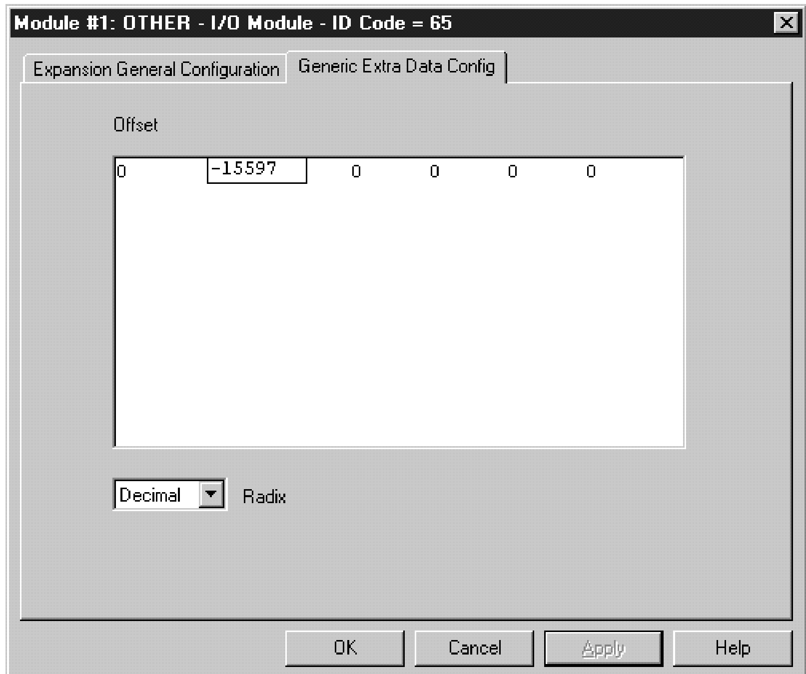


The 1762-IR4 uses six 16-bit binary numbers to configure each of its four channels. To properly configure and enable input channel 1 for the setting in the table below, add the decimal values given to each of the six parameters. These decimal values are listed in Table 3.4, 'Channel Configuration Bit Definitions,' on page 3-8.

Table B.B 1762-IR4 Parameter Decimal Values

Parameter	Setting	Decimal Value
Input Type	200Ω Platinum 385	256
Data Format	Engineering Units x 10	16384
Temperature Units	Degrees F	128
Broken Input	Upscale	0
Disable Cyclic Lead Compensation	Enable	0
Excitation Current	1.0 mA	0
Input Filter Frequency	250 Hz	3
Channel Enable/Disable	Enable	-32768
	Total	**-15997**

Enter -15597 into the Generic Extra Data Config Tab as shown below.



The following terms and abbreviations are used throughout this manual. For definitions of terms not listed here refer to Allen-Bradley's Industrial Automation Glossary, Publication AG-7.1.

A/D Converter

Refers to the analog to digital converter inherent to the module. The converter produces a digital value whose magnitude is proportional to the magnitude of an analog input signal.

attenuation

The reduction in the magnitude of a signal as it passes through a system.

bus connector

A 16-pin male and female connector that provides electrical interconnection between the modules.

channel

Refers to input interfaces available on the module's terminal block. Each channel is configured for connection to a thermocouple or millivolt input device, and has its own data and diagnostic status words.

channel update time

The time required for the module to sample and convert the input signals of one enabled input channel and update the channel data word.

common mode rejection

For analog inputs, the maximum level to which a common mode input voltage appears in the numerical value read by the processor, expressed in dB.

common mode rejection ratio (CMMR)

The ratio of a device's differential voltage gain to common mode voltage gain. Expressed in dB, CMRR is a comparative measure of a device's ability to reject interference caused by a voltage common to its input terminals relative to ground. CMRR=20 Log10 (V1/V2)

common mode voltage

The voltage difference between the negative terminal and analog common during normal differential operation.

common mode voltage range

The largest voltage difference allowed between either the positive or negative terminal and analog common during normal differential operation.

configuration word

Word containing the channel configuration information needed by the module to configure and operate each channel.

cut-off frequency

The frequency at which the input signal is attenuated 3 dB by a digital filter. Frequency components of the input signal that are below the cut-off frequency are passed with under 3 dB of attenuation for low-pass filters.

data word

A 16-bit integer that represents the value of the input channel. The channel data word is valid only when the channel is enabled and there are no channel errors. When the channel is disabled the channel data word is cleared (0).

dB (decibel)

A logarithmic measure of the ratio of two signal levels.

digital filter

A low-pass filter incorporated into the A/D converter. The digital filter provides very steep roll-off above it's cut-off frequency, which provides high frequency noise rejection.

effective resolution

The number of bits in a channel configuration word that do not vary due to noise.

excitation current

A user-selectable current that the module sends through the input device to produce an analog signal that the module can process and convert to temperature (RTD) or resistance in ohms (resistance device).

filter

A device that passes a signal or range of signals and eliminates all others.

filter frequency

The user-selectable frequency for a digital filter.

full-scale

The magnitude of input over which normal operation is permitted.

full-scale range

The difference between the maximum and minimum specified analog input values for a device.

gain drift

Change in full-scale transition voltage measured over the operating temperature range of the module.

input data scaling

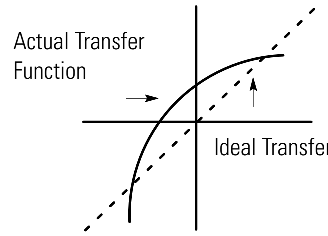
Data scaling that depends on the data format selected for a channel configuration word. Scaling is selected to fit the temperature or voltage resolution for your application.

input image

The input from the module to the controller. The input image contains the module data words and status bits.

linearity error

Any deviation of the converted input or actual output from a straight line of values representing the ideal analog input. An analog input is composed of a series of input values corresponding to digital codes. For an ideal analog input, the values lie in a straight line spaced by inputs corresponding to 1 LSB. Linearity is expressed in percent full-scale input. See the variation from the straight line due to linearity error (exaggerated) in the example below.



LSB

Least significant bit. The LSB represents the smallest value within a string of bits. For analog modules, 16-bit, two's complement binary codes are used in the I/O image. For analog inputs, the LSB is defined as the rightmost bit of the 16-bit field (bit 0). The weight of the LSB value is defined as the full-scale range divided by the resolution.

module scan time

same as module update time

module update time

The time required for the module to sample and convert the input signals of all enabled input channels and make the resulting data values available to the processor.

multiplexer

An switching system that allows several signals to share a common A/D converter.

normal mode rejection

(differential mode rejection) A logarithmic measure, in dB, of a device's ability to reject noise signals between or among circuit signal conductors. The measurement does not apply to noise signals between the equipment grounding conductor or signal reference structure and the signal conductors.

number of significant bits

The power of two that represents the total number of completely different digital codes to which an analog signal can be converted or from which it can be generated.

overall accuracy

The worst-case deviation of the digital representation of the input signal from the ideal over the full input range is the overall accuracy. Overall accuracy is expressed in percent of full scale.

repeatability

The closeness of agreement among repeated measurements of the same variable under the same conditions.

resolution

The smallest detectable change in a measurement, typically expressed in engineering units (e.g. 1°C) or as a number of bits. For example a 12-bit system has 4096 possible output states. It can therefore measure 1 part in 4096.

RTD

Resistance temperature detector. A temperature-sensing device that consists of a temperature-sensing element connected by two, three, or four lead wires that provide input to the module. The RTD uses the basic concept that the electrical resistances of metals increase with temperature. When a small current is applied to the RTD, it creates voltage that varies with temperature. The module processes and converts this voltage into a temperature value.

sampling time

The time required by the A/D converter to sample an input channel.

step response time

The time required for the channel data word signal to reach a specified percentage of its expected final value, given a full-scale step change in the input signal.

update time

see “module update time”

W

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